FOREST PRACTICES BRANCH

Stocking and Free Growing Survey Procedures Manual

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Preface

The Forest Practices Branch has prepared this manual to act as a reference guide for data collection and compilation of stocking and free growing surveys. These surveys are conducted to meet the legal obligations described in the *Forest Practices Code of British Columbia Act*, Silviculture Practices Regulation, and Woodlot Licence Forest Management Regulation. This manual is intended to replace the technical survey procedures specifically for stocking and free growing surveys found in the *Silviculture Surveys Guidebook*.

This *Stocking and Free Growing Surveys Procedures Manual* will be subject to ongoing review by Ministry of Forests (Ministry) and non-Ministry survey experts, and will continue to be updated as survey methods improve. It currently contains the best management practices to guide surveyors in completing stocking and free growing surveys on areas that have a silviculture prescription. These survey practices can also be applied to areas that do not have silviculture prescriptions (e.g., pre-1987 harvesting). The information in this manual is current as of March 2002.

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1 Introduction

1.1 Format of This Document

This manual has been written to correspond with the chronological sequence in which surveys are conducted, from the office preparation to the final survey report that is submitted to the Ministry of Forests. This manual also describes the best management practice for silviculture surveys conducted in British Columbia.

Best management practice is the commonly accepted best way of completing a task. These procedures have been tried and tested over time, and meet Ministry standards of performance. Where efficiencies can be gained, changes to the standard practices described in this manual are encouraged but should be discussed with both Ministry Silviculture, and Compliance and Enforcement staff to ensure they are acceptable and meet district manager approval.

Specifications within a signed contract and regional or district standard operating procedures may take precedence over the guidance provided here.

Please contact the Forest Practices Branch provincial silviculture surveys specialist if you have recommendations for improvements to this manual.

New ideas and concepts, as well as commonly misunderstood issues, have been highlighted using a box like this one.

This document contains numerous links to additional references found on the Internet or within this document, such as the glossary in Appendix 1. These links are formatted in blue and underlined.

1.1.1 Audience

The procedures described in this manual are intended to guide individuals who conduct or monitor silviculture surveys on forest land within British Columbia. These procedures have been developed to meet or exceed the requirements of the *Forest Practices Code of British Columbia Act* and applicable Regulations.

1.1.2 Background

The *Ministry of Forests Act* requires the Ministry of Forests to manage, protect, and conserve the forest resources of the Crown. The *Forest Practices Code of British Columbia Act* requires that major licensees, woodlot licensees, and the Small Business Forest Enterprise Program establish and maintain a crop of commercially valuable species on harvested areas. Standards describing what must be regenerated and the time limits for establishment of the crop are set in silviculture prescriptions. This manual describes the methods used to measure the achievement of these standards.

Each year, silviculture surveys are conducted on approximately 1 million hectares of Crown land. Silviculture surveys exceed the area treated of all other silviculture activities combined.

Per hectare, silviculture surveys are one of the lowest cost silviculture activities. This, however, does not mean that they are of little value. Surveys costing only a few dollars per hectare provide the information necessary to prescribe silviculture treatments costing upwards of thousands of dollars per hectare.

Silviculture surveys assemble the baseline information required to develop and implement effective silviculture programs. They are an essential element in the confirmation of a completed silviculture obligations, and may also be used in assessment of due diligence with respect to achievement of free growing obligations.

Survey information may be used for planning treatments, conducting resource analyses, preparing annual reports, conducting audits, or monitoring compliance with silviculture prescriptions. Forest managers are using this information increasingly as the input data for growth projection models. Survey data can also be used to update long-term history files for openings and forest cover maps.

Accuracy and consistency in conducting surveys are vitally important. Poor or incorrect data collection can result in improper treatments being recommended and completed, or lead to incorrect land status classification.

Figure 1. Conceptual flow of the silviculture survey process.

In Figure 1, the inner blue line represents stocking surveys and the outer green line represents free growing surveys. The red text represents the four steps in the survey process.

1.1.3 Survey Principles

The survey methods in this manual have been carefully developed to promote a balance between the costs of performing surveys and the acceptable risk levels that the Ministry can place on the data collected from these surveys.

The basic survey principles are based on an understanding of:

- the Ministry of Forests legislated responsibility to manage, protect, and conserve the forest resource;
- a licensee's freedom to manage the forest resource (within the context of their licence agreement and the legal framework);
- the expectation of professionalism within the community of silviculture surveyors; and
- the role of audits at all levels to ensure quality.

Standardized concepts must be upheld throughout the planning, implementation, and audit phases of all silviculture surveys. This ensures the survey system remains consistent and predictable. Specific issues may be discussed in individual contracts; however, the standardized concepts should take precedence. If any of the standardized concepts are not respected, the survey and the survey results could be rejected.

Conducting most silviculture surveys follows four steps:

1. review currently available information, especially the silviculture prescription and its associated approved amendments;
2. identify strata within the opening, especially those identified in the silviculture prescription;
3. collect data within each stratum; and
4. summarize data and prepare and submit a report.

Consistent and accurate data collection, summarization, data analysis, and treatment recommendations are essential. Poor survey data can result in major fines to licensees, and registered professional foresters (RPF) who submit reports based on poor survey data are held professionally accountable for their actions.

Failure to follow the standardized silviculture survey procedures set out in this manual can have costly implications. *Forest Practices Code of British Columbia Act*, Operational Planning Regulation, and the Silviculture Practices Regulation establish survey requirements. The Administrative Remedies Regulation outlines penalties that face licensees who fail to meet the requirements. For example, the fine is $100,000 for not achieving a free growing stand by the end of the free growing assessment period specified in the silviculture prescription.

1.1.4 Legislative Requirements

The *Forest Practices Code of British Columbia Act* Section 70(3) requires the holder of a silviculture prescription to establish a free growing stand on those portions of the area under the prescription that are within the net area to be reforested.

The legislative requirement to perform the surveys discussed in this manual is established in Section 70(4) of the *Forest Practices Code of British Columbia Act*. It directs persons who are required to establish a free growing stand to perform stocking surveys and free growing surveys, with the consideration of maximum density and the assessment of forest health factors at the times and in the manner specified in regulations and standards.

The Silviculture Practices Regulation provides a framework for monitoring a silviculture prescription holder's obligations for stand development. The final stage in this process is the free growing survey. If

the free growing requirements have been met at any time within the free growing assessment period, the requirements of the *Forest Practices Code of British Columbia Act* Section 70(3) are deemed to have been achieved.

Sections 23, 24, 25, and 26 of the Silviculture Practices Regulation describe more of the specific legislative, silviculture survey requirements. Sections 28 and 29 describe the reporting requirements. The information required in the legislated reports comes from silviculture survey data summaries; however, the surveys themselves contain more information than required in the reports.

Legally Required Surveys

Survey type	Objectives	Timing	Reference
Stocking	To meet reporting requirements, to determine need for treatments	Snow-free seasons, before the regeneration date	This manual and the Silviculture Practices Regulation Section 23(1)(b)
Free growing	To meet reporting requirements, to determine need for treatments, and to provide the district manager with sufficient information to determine if a free growing stand has been established	Within the free growing assessment window. Summer where herb competition is present and any time of year for shrub and broadleaf tree competition.	This manual, *Establishment to Free Growing Guidebook*, and the Silviculture Practices Regulation Section 23(1)(c)
Soil conservation (legally required if requested by the district manager)	To determine extent of the area occupied by permanent access structures, and soil disturbance in the net area to be reforested (NAR), including temporary access structures		Silviculture Practices Regulation Section 23(1)(c), *Soil Conservation Guidebook, and Soil Conservation Surveys Guidebook*

Components of Stocking and Free Growing Surveys

Survey type	Objectives	Timing	Associated with other surveys	Reference
Forest health	To determine the incidence of forest health factors present	Any time of year, although some forest health factors are more easily identified at certain times of the year	Stocking and free growing surveys	*Damage Agent and Condition Codes FS 747*, FS 660, and *Free Growing Damage Criteria in the Establishment to Free Growing Guidebook*
Site index determination	To determine the potential site productivity	Any time of year	Stocking and free growing surveys	*Site Index Estimate by Site Series*
Plantability	To determine the need for site preparation treatment and the number of plantable spots available	During snow-free periods, in the first few years following harvest	Stocking surveys	none
Brushing/ Vegetation hazard	To assess vegetative competition and tree condition, to determine the need for treatment, and to determine the most appropriate type of treatment	Before the late free growing date. Summer for herb competition and any time of year for shrub and broadleaf tree competition	Stocking and free growing surveys	none
Inventory	To collect inventory attributes	Any time of the year	Stocking and free growing surveys	none

Other Silviculture Survey Types

Survey type	Objectives	Timing	Associated with other surveys	Reference
Cone and seedbed	To determine the need for drag scarification	Shortly following the completion of harvesting operations	Can be in conjunction with stocking and plantability surveys	*Fundamentals of Natural Lodgepole Pine Regeneration and Drag Scarification*, *Soil Conservation Guidebook*, and *Soil Rehabilitation Guidebook*
Planting quality inspection	To determine the quality of the planting and payment percentage	Upon completion of the planting treatment	Planting project administration. Can be in conjunction with stocking surveys.	*Planting Quality Inspection: Completing the FS 704*
Brushing/ vegetation treatment quality inspection	To determine the quality of the brushing treatment and payment percentage	Upon completion of the brushing treatment	Brushing/ vegetation treatment projects. Can be in conjunction with stocking surveys.	*Manual Brushing Inspection Report* (FS 209)
Pre-stand tending	To gather data that aid in determining stand tending treatments	Any time of the year, usually after regeneration stage to after late free growing date	Can be done in conjunction with stocking or free growing surveys	Revised procedures are under review
Juvenile spacing quality inspection	To determine the quality of the spacing treatment and payment percentage	Upon completion of the spacing treatment	Stocking and free growing surveys	*Juvenile Spacing Quality Inspection* booklet
Green-up	To determine if a previously harvested area has been sufficiently re-vegetated to allow for harvesting an adjacent area	Before the harvest of adjacent stand constrained by green-up requirements Any time of the year	Can be done in conjunction with free growing surveys	*Green-up Guidebook*, Sections 67 and 68 of the Operational Planning Regulation, and Timber Harvesting Regulation

Variations on Stocking and Free Growing Surveys

Survey type	Objectives	Timing	Associated with other surveys	Reference
Multi-storey	To confirm the stocking level, species composition and stand structure in a single tree selection silvicultural system	Snow free seasons, before the regeneration date, and within the free growing assessment window. Summer where herb competition is present and any time of year for shrub and broadleaf tree competition.		This manual Under revision spring 2002
Intermediate cut	Confirm the stocking level, species composition and stand structure in a shelterwood silvicultural system	Following each harvesting activity in a shelterwood silvicultural system.		none

2 Defining Survey Objectives

Before conducting any survey, the objectives of the survey must be clearly defined. Survey objectives often include assessing the site and stand conditions, determining if the reforestation obligations have been met, prescribing the need for future treatments, and generating a map and an updated inventory label for the forest cover map.

Several questions must be answered before a silviculture survey is initiated:

1. What decisions need to be made about the opening?
2. What data need to be collected?
3. What intensity of plots should be established?
4. Is this the optimum season to conduct the survey?
5. Does the silviculture prescription or Forest Practices Code legislation specify that a survey be carried out at this time?
6. Can this survey be combined with other surveys?

2.1 Combining Surveys

During the walk-through, the surveyor may determine that another type of survey is required, in addition to the survey being conducted. For example, a surveyor was initially instructed to do a stocking survey, yet the opening has a broadleaf component that needs to be addressed. Therefore, a stocking survey and a vegetation assessment survey should be combined.

A second example of combining surveys could be a stocking/free growing survey. This is a stocking survey in which free growing data are also collected. Collecting free growing information during a stocking survey is helpful for assessing how far along an area is to becoming free growing. This information is also useful in identifying areas that require treatment(s) before the free growing survey.

When combining surveys, the objectives of each survey must be kept in mind, because the tally procedures for each may be quite different. As well, the surveyor must remember to collect all information necessary to show compliance. Although combined surveys might seem complex, they are more cost effective and efficient than conducting two separate surveys.

2.1.1 Survey Timing

Survey timing is an issue usually left to the manager of the silviculture program for a licensee, but is also useful for individual surveyors to understand the issue. Silviculture prescriptions usually specify the regeneration date and early and late free growing assessment dates in terms of the number of years following the commencement of harvest. Some have thought this to be synonymous with the number of growing seasons. This is not the case. Nor is it the completion of harvesting activities. The anniversary of the beginning of the harvesting becomes a very important reference date. Openings harvested over multiple years can cause some very difficult regeneration problems.

Surveys that will be used to report meeting the regeneration obligation or the free growing declaration should be scheduled with some consideration. An area harvested in late winter may be still snow covered on the anniversary of the commencement of harvesting. Practically, this means the stocking survey may

have to be completed up to 6 months earlier than the maximum length of the regeneration period. This is not a flaw in the system, but simply a factor that must be considered in survey program planning.

The *Forest Practices Code of British Columbia Act* stipulates that silviculture prescriptions must include a time frame for establishment of a new stand and for the new stand to be declared free growing. Commencement dates are recorded to the level of month and year in the Ministry's Integrated Silviculture Information System (ISIS) and subsequent dates are tracked to that level of accuracy. For example, if harvesting began January 1997, a 3-year regeneration delay would expire at the end of January 2000, and an 11-year latest free growing date would expire at the end of January 2007. Figure 4 in the *Establishment to Free Growing Guidebook* provides a timeline and summary of dates, including associated responsibilities, to be identified in the silviculture prescription.

In this example, the last reasonable time to complete the stocking survey will be fall of 1999. Leaving the survey to this late date leaves the licensee at some risk. What if the area is not sufficiently restocked? There is no practical way to remedy the problem in time to meet the deadline.

If a manual brushing treatment were completed any later than very early spring 2004, it would not be possible to complete 3 years and a survey during full leaf-out before the late free growing date of January 2007. Because we know brushing is more effective for many species when conducted in early summer (mid growing season), this practically means the brushing should be completed the previous year. Then, what if the brushing treatment must be repeated for full effectiveness?

2.1.1.1 Timing of Stocking Survey

Stocking surveys must be completed on or before the regeneration date. A person who is required to establish a free growing stand must conduct a stocking survey in accordance with the Silviculture Practices Regulation Section 23(1)(b), specifically, before the regeneration date, or within the regeneration delay period.

The optimum time of year to do the field assessment for stocking surveys is either early in the spring, before height growth has started and before vegetation makes work difficult, or in the fall, after height growth has been completed, but before snowfall. In areas that are prone to vegetation encroachment, stocking surveys should be done before leaf-out, or after leaf fall. This will reduce the likelihood of missing trees during data collection.

2.1.1.2 Timing of Free Growing Survey

Stocking surveys must be completed on or before the regeneration date.

A person who is required to establish a free growing stand must conduct a free growing survey in accordance with the Silviculture Practices Regulation Section 23(1)(c). They must do so within the free growing assessment period specified in the silviculture prescription, specifically, after the early free growing assessment date and before the late free growing assessment date. As with stocking surveys, pre-planning may be required to ensure the survey can be completed at the appropriate time of year, and before the anniversary date of the commencement of harvest.

In areas where vegetation competition may be a factor in free growing determination, free growing surveys should be done between the time of maximum leaf-out and before leaf fall. This will ensure that the vegetation encroachment on the well-spaced trees can be properly assessed.

On sites where vegetation competition is not a factor in determining free growing status, the survey can be done any time of the year, subject to snowfall.

After a juvenile spacing treatment has been completed, a waiting period is not required before conducting a free growing survey.

Current policy requires waiting 2 or 3 years (Table 1) after a brushing treatment before the area can be declared free growing. This required waiting period was implemented to ensure that the crop trees were truly healthy and free from competing vegetation. However, if the district manager is confident that after a brushing treatment, the crop trees will remain free from impeding vegetation and that the trees are healthy (not suffering from a side effect of brushing treatment), a free growing survey could be accepted before the "standard" waiting period.

Table 1. Number of years' growth required following a brushing treatment before a free growing survey

Biogeoclimatic zone	Number of years
ICH, IDF, MS, PP, BG, SBPS, CWH, CDF, MH, and ESSF	2
SBS and BWBS	
• following herbicide treatment	2
• manually or otherwise treated	3

For intermediate, salvage, and preparatory cuts, where the silviculture prescription indicates that there are no regeneration objectives, the survey must be conducted more than 1 year after the completion of harvesting. See Sections 25 and 26 of the Silviculture Practices Regulation.

Prompt or aggressive silviculture treatments may result in the area being stocked sooner than specified in the silviculture prescription (i.e., reducing the regeneration date from 4 years to 2 years.) A licensee may apply to the district manager to reduce the early free growing assessment date by an equivalent period. This incentive encourages prompt silviculture treatments in exchange for early relief of reforestation obligations.

In general, it is prudent to schedule free growing surveys as early as possible in the development of the stand. This allows for the identification of issues early, and the opportunity to manage the issues before the late free growing assessment date.

3 File Review and Office Preparation

3.1 File Review

The objective of a file review is to make a preliminary assessment of the site and stand conditions, identify the survey standards from the silviculture prescription, and determine the history of previous activities. In general, gain as much knowledge of an area from the pre-existing data as possible and as a result be more prepared to gather the correct data during the upcoming survey.

The following is a list of information that a surveyor should consider before conducting any silviculture survey:

- silviculture prescription and any amendments
- silviculture treatment regime
- forest cover map
- aerial photos
- ISIS or other database describing history, specifically, the Opening Summary Report
- silviculture treatment prescriptions
- treatment reports
- previous surveys
- previous methods of site index determination

Once the reference materials and information are gathered for each opening and have been reviewed, some of the fields on the Silviculture Survey (FS 657) card can be completed. A few examples of these include the opening number, licence number, licensee, stocking standards, forest region, and forest district.

Many of the site description data fields of the FS 657 field card can be found within the opening file. However, these items should be confirmed during the walk-through. These fields include the soil texture, elevation, aspect, slope percentage, survey date, and ecological classification.

If the file review indicates that site index has been accurately determined by the growth intercept method during a previous survey, it may be unnecessary to collect site index information again during the proposed survey. The previously determined site index can be reused in the results of this survey. It is, however, always prudent to confirm the accuracy of previously collected data.

3.2 Silviculture Prescription

Before a survey is carried out on an opening, surveyors must familiarize themselves with the opening and, in particular, the associated silviculture prescription. Silviculture prescriptions contain management objectives and stocking standards that will be used during surveys to measure the success of re-establishing a free growing stand. The silviculture prescription is a site-specific plan describing the nature and extent of timber harvesting and silviculture activities proposed for an opening. Only older silviculture prescriptions will have silviculture activities specified in them. In newer silviculture prescriptions, the surveyor should review the silviculture treatment regime.

The silviculture prescription is the source of the standards and parameters used to conduct the survey. **Surveyors do not create the standards used for the survey blocks harvested after October 31, 1987.**

Pre-harvest silviculture prescriptions are the "pre-Forest Practice Code" equivalent to silviculture prescriptions. Prior to April 1, 1994, all silviculture prescriptions were called pre-harvest silviculture prescriptions. Throughout this manual, all prescriptions (whether pre-harvest silviculture prescriptions or silviculture prescriptions) are referred to as silviculture prescriptions.

Silviculture prescriptions on backlog areas may have been prepared for treatments conducted after the Forest Practices Code came into effect. The silviculture prescriptions on these backlog areas are followed in the same manner as those on current areas. Occasionally, silviculture prescriptions were prepared for these areas before they were required by the Forest Practices Code.

In 1998, the regulation of woodlots was consolidated into the Woodlot Licence Forest Management Regulation. In this document, a new form of silviculture prescription was created called the Site Plan, which has much of the same contents as a silviculture prescription. Surveyors use the Site Plan in the same manner as they would a silviculture prescription. Because they are similar in content and relevance to silviculture surveys, this procedures manual makes no distinction between these two forms for setting survey standards. Where the procedures manual refers to a silviculture prescription, the implications apply equally to Site Plans.

3.2.1 Silviculture Prescription Amendments

Periodically, the content of a silviculture prescription requires changes. This may be a result of the reconsideration of the biological characteristics of the site, or to remedy a previously unrecognized data entry error, or for many other reasons. Because the silviculture prescription is essentially a contract between a licensee and the Ministry of Forests, both parties must agree to any changes.

The surveyor, before embarking on a survey, must be aware of amendments. If an amendment has been previously approved, it replaces specific components of the silviculture prescription. This must be reflected in the survey that is about to be conducted.

A more complex issue is if an amendment has been applied for but not yet approved. There may be a cover letter, or copy of an unapproved amendment found on the opening file. A licensee may propose an amendment, but it only becomes a legal amendment to the silviculture prescription once the district manager has approved it. The surveyor should further investigate this with the project administrator or supervisor.

Unless a prior understanding has been reached between the surveyor(s), the district manager, and the licensee, the proposed amendments should not be incorporated into the survey methodology until the district manager has approved the silviculture prescription amendment.

A licensee must prepare an amendment to the silviculture prescription if it becomes evident that the desired results of the silviculture prescription are not achievable. Sections 34–36 of the *Forest Practices Code of British Columbia Act* describe the legislative requirements of amendments. Surveyors should be aware of this scenario when conducting a walk-through and when preparing treatment recommendations. A recommendation to prepare an amendment for a biologically necessary reason is expected of a silviculture surveyor.

In addition, other reasons may also require amendments. While these can be district specific, surveyors should also consider recommending an amendment when:

- the area has changed by more than an amount set by the Ministry of Forests branch, region, or district;
- the biogeoclimatic description, and subsequent stocking standards are not representative of the current site conditions found on the opening.

In selected situations where licensees employ surveyors skilled in developing stocking standards for silviculture prescriptions, it may be suitable to collect data using both the specifications in the approved silviculture prescription as well as the proposed amendment specifications. This additional information can be used to justify an amendment and will eliminate the need for an additional survey.

3.2.2 Pre-1987 Stands with No Silviculture Prescription

Surveys conducted on areas harvested prior to October 31, 1987, may pose complications for surveyors. Surveyors are faced with attaining standards and parameters when most areas harvested prior to October 31, 1987, do not have silviculture prescriptions. If there is no backlog silviculture prescription in place, the district manager is responsible for establishing the standards.

Some regions and districts have prepared procedures for conducting surveys on backlog areas. However, surveyors may be required, as a contract stipulation, to stratify based on biogeoclimatic ecosystem classification and to use the current stocking standard guidelines found in the *Establishment to Free Growing Guidebook*. This is the only situation where surveyors may be asked to create stocking standards. **This type of survey work is suitable for experienced surveyors only.**

Surveyors should familiarize themselves with the *Backlog Management Policy* (*Ministry of Forests Policy Manual, Volume 1-Resource Management*) before conducting surveys on areas harvested prior to October 31, 1987.

3.3 Standards Unit versus Treatment Unit

Silviculture prescriptions have evolved over the years. One of the changes has been the use of the terms "Treatment Unit" and "Standards Unit." The current definitions are as follows:

Standards Unit (SU): An area that is managed through the uniform application of a silvicultural system, stocking standards, and soil conservation standards. These standards are used to determine if legal regeneration, free growing, and soil conservation obligations are met.

Treatment Unit (TU): An area of land upon which a silviculture activity is planned and carried out.

Note: There may be more than one TU or stratum within a Standards Unit. Many older prescriptions use the term "Treatment Unit" in place of "Standards Unit." If more than one Treatment Unit has identical stocking standards, these Treatment Units can be surveyed as a single stratum, all other parameters being similar. If they use different standards, consider them as different Standards Units.

3.3.1 Stocking Requirements

Since the requirement for a silviculture prescription was first established, the document has evolved. Content requirements have changed. The size of a typical silviculture prescription has ranged from one to dozens of pages. However, silviculture prescriptions have always contained stocking standards.

The replacement of the Silviculture Regulations by the Silviculture Practices Regulation in the spring of 1994 was a substantial landmark for many of the changes.

3.3.1.1 MSS versus MSSp versus MSSpa

With the creation of the Silviculture Practices Regulation in April 1994, one of the new requirements for silviculture prescriptions was the addition of the minimum number of preferred species. The goal of this requirement was to ensure that reforestation activities be targeted to produce not just species that are ecologically suited to the site *but also* to produce those species that have the greatest commercial viability.

For example, a silviculture prescription indicates:

- Douglas-fir and spruce are preferred and western hemlock is acceptable
- the minimum stocking standard is 700 trees per hectare
- the minimum preferred stocking standard is 600 trees per hectare

This sample opening must have at least 700 free growing trees per hectare in any proportion of Douglas-fir, spruce, and western hemlock. However, there must be at least 600 free growing trees per hectare in any combination of Douglas-fir and/or spruce for the area to be considered free growing.

The minimum stocking standard is often abbreviated as MSS or MSSpa, while the minimum preferred stocking standard is abbreviated as MSSp.

The minimum preferred stocking standard concept is only a requirement if it is specifically stated in the silviculture prescription. Silviculture prescriptions approved prior to April 1, 1994, will not have minimum preferred stocking standards. Virtually all silviculture prescriptions refer to both preferred and acceptable species in their stocking standards or stocking requirements section, but these silviculture prescriptions only have a minimum number of preferred trees per hectare if it is explicitly stated.

3.3.1.2 Order of Species

While there is great significance in the designation of preferred and acceptable species, there is no significance in the order, or relative position, in which they are recorded in the stocking standards section of the silviculture prescription.

3.3.1.3 Implied MSSp

Some older silviculture prescriptions used a method of placing parentheses around those species that would be restricted to a certain percentage of the minimum stocking standard. For example, upon review of an older silviculture prescription, Douglas-fir, spruce, and (western hemlock) are listed as the acceptable species in the stocking standards section. This would suggest that, when determining stocking status, only a small percentage of the minimum stocking standard could be comprised of western hemlock. The actual percentage must be specified in the silviculture prescription. It may also be appropriate to contact the local forest district office to identify the correct percentage for the era of the silviculture prescription. The maximum percentage of "bracketed species" ranged from 10 to 30%.

Some regional policies instructed licensees and the Small Business Forest Enterprise Program to include wording in silviculture prescriptions that described the minimum number of preferred species. For example, a 1991 Vancouver Forest Region directive required the inclusion of a commitment that "the preferred species will consist of no less than the minimum stocking standard at regeneration delay and no less than 100 under the minimum stocking standard at free growing."

3.3.1.4 "Double Standards"

Some older silviculture prescriptions (found in the Kamloops Forest Region in particular) contain two sets of stocking standard values. The most common format indicates one set of stocking standards for pure lodgepole pine stands and a second set for "other" species. The "Pli" standards are used where the silviculture label has 80% or more lodgepole pine; otherwise, the "other" standards are used.

3.3.1.5 Minimum Horizontal Distance

Minimum inter-tree distance is an important component of the stocking standards and survey parameters. The silviculture prescription specifies a minimum horizontal inter-tree distance. All trees considered well spaced or free growing must be at least this specified distance from other well-spaced or free growing trees.

If a minimum horizontal inter-tree distance is not specified, discussions may be required between the licensee and the Ministry of Forests. From 1994 to 1998, the default inter-tree distance was assumed to be 2.0 m if it was not specified in the silviculture prescription.

Some silviculture prescriptions provide for the minimum inter-tree distance to be changed to be the same as the inter-tree distance allowed at the time of planting.

3.3.1.6 Target Leader Growth

Through the late 1980s and early 1990s, silviculture prescriptions included a specification called target leader growth or target leader length in the stocking standards. The intent was to ensure that not only sufficient quantities of trees were present on the site but that they were also growing at a minimum rate. A species-specific growth rate per year or per 3-year period was common. The concept of minimum growth rates was replaced by the minimum free growing height in later silviculture prescriptions.

If a silviculture prescription states a minimum leader growth, that value is enforceable. However, a method of assessing was never standardized and must therefore be determined in consultation between the Ministry of Forests and the licensee.

> Target leader growth is not a legally binding requirement of the stocking standards. Compliance with target leader growth if specified in a silviculture prescription is not required. It may, however, be used on a site-specific basis as a measure of due diligence.

3.3.1.7 Minimum Free Growing Height

The 1994 Silviculture Practices Regulation added the prescription requirement that a minimum height for a crop tree be achieved before the tree could be considered free growing. If these values are not found in the silviculture prescription, then there are no legal requirements for a tree to meet a minimum height specification. The only exception to this is if the surveyor is using the revised free growing guidelines found in Appendix 9 of the *Establishment to Free Growing Guidebook*, in which case a minimum height is required.

3.3.1.8 Adjustment of the Early and Late Free Growing Dates

The subject of changing the early and late free growing dates, also known as the "sliding rule," is discussed in the *Establishment to Free Growing Guidebook* (page 35).

3.3.1.9 Minimum Age of a Free Growing Tree

There is no legally required minimum age of a free growing tree, unless it is specifically stated in the silviculture prescription. The 5- and 8-year minimum time elapsed does *not* refer to tree age, but to the "waiting period" from the time the opening is considered sufficiently regenerated (regeneration date) to the point at which the opening is declared free growing (at least the early free growing date). This 5- and 8-year period can also be shortened at the discretion of the district manager.

For surveys on single tree selection systems, the *Establishment to Free Growing Guidebook* (page 38) indicates that free growing trees must be on site for 5 years and be 40 cm tall.

3.4 Preliminary Stratification

In the office review, the surveyor uses the information found in the opening file, in the silviculture prescription, and in the corporate database for the preliminary stratification. The data found on file, including air photos, previous surveys, previous treatments, and other maps, provide the background for an opening, and can help give an initial impression of what can be expected.

The first step in preliminary stratification for any stocking or free growing survey is to identify the Standards Unit(s) described in the silviculture prescription. Each Standards Unit has distinct survey parameters, and must be surveyed independently of the others to ensure legal stocking and free growing requirements have been achieved. Additional stratification may be required based on a re-evaluation of the biogeoclimatic ecosystem classification. This must be done with special care because it may result in the need for an amendment to the silviculture prescription. Standards Units are often subdivided, or stratified for any one of a number of forest cover, stocking status, or treatment reasons.

In a few rare cases, it is possible to survey two Standards Units as one stratum. This is only possible if the stocking standards in the silviculture prescription are identical, and the two areas are significantly similar (not different enough to be stratified). This can save some time on blocks where Standards Units are based on soil disturbance limits rather than stocking standards. It may also be advisable to discuss this with the project coordinator.

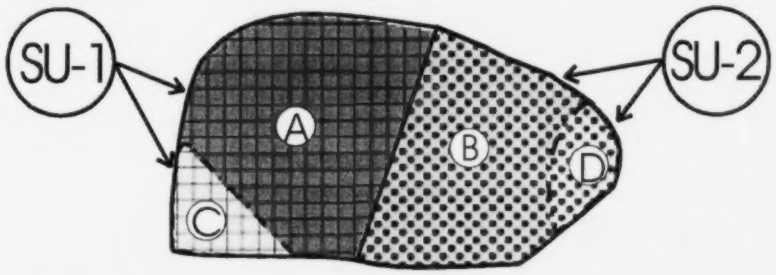


Figure 2. Preliminary stratification.

An example map (Figure 2) depicting a realistic opening has been provided to assist with the description of preliminary stratification.

The cross-hatched area is Standards Unit 1 (SU-1); the dotted area is Standards Unit 2 (SU-2).

Regardless of any other subsequent stratification, the boundary between stratum A and stratum B must be maintained.

In the silviculture prescription, Standards Unit 1 has two Treatment Units. The stocking standards for TU-2 are the same as TU-1, but TU-2 has a restriction for no ground-based machinery to be used. We suspect there may be something different about this area. It is therefore split into two strata, A and C, on the expectation that some conditions within SU-1 will be different. Once the walk-through has been completed, this stratification will be confirmed or eliminated.

Upon further review of the information on file, the recent air photo indicates lighter colour at the right point of SU-2. The cause is currently unknown. This portion of stratum B appears to be different from the remainder of the stratum. Stratum D is therefore noted and will be investigated during the walk-through.

This and other preliminary stratification will be reconsidered during the walk-through. The Standards Unit boundary is not reconsidered; it remains fixed unless an amendment to the silviculture prescription is prepared.

Figure 3 provides the final stratification for our fictional opening. During the walk-through it was confirmed that stratum A and C are significantly different. As result of the machine-free restriction, the understorey of previously suppressed balsam was not damaged during harvesting or mechanical site preparation. There are far more balsam, although of poor quality, in the south-east corner. Stratum C is retained and surveyed separately.

Stratum D turned out to have a higher percentage cover of grass than the remainder of the east half of the opening. While it appears to be a different colour on the air photo, the difference in herb species or grass species on this stratum does not affect the stand composition and density, and the free growing trees. The stratification prior to establishing plots has been finalized as seen in Figure 3.

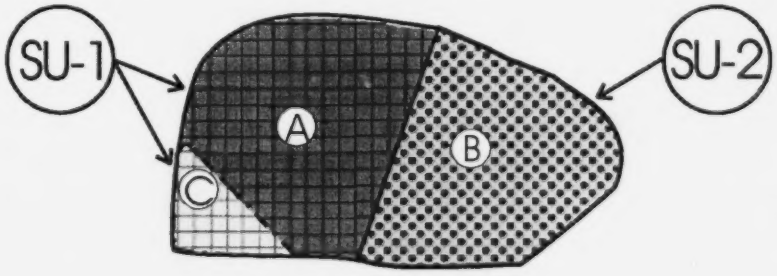


Figure 3. Final stratification following the walk-through.

The title of Figure 3 is also significant—stratification is finalized at the completion of the walk-through. Stratification based primarily on the data found within plots at the completion of the survey is an unacceptable practice. It should be a *very rare* incident that requires stratification following the data collection phase of the survey.

3.5 Plot Radius and Plot Multiplier

Circular plots with a known radius are integral to the sampling procedure. The most common plot radius for the collection of silviculture data is 3.99 m. A plot with a 3.99-m radius has an area of 50 m^2. This is determined using the formula for calculating the area of a circle. A hectare is 10 000 m^2. This means that a 3.99-m plot represents 1/200 of a hectare. The plot multiplier is determined by dividing 10 000 m^2 by 50 m^2 (Figure 4). Therefore, the plot multiplier is 200. The same mathematical principles can be applied to a plot radius of 5.64 m. The plot multiplier is 100.

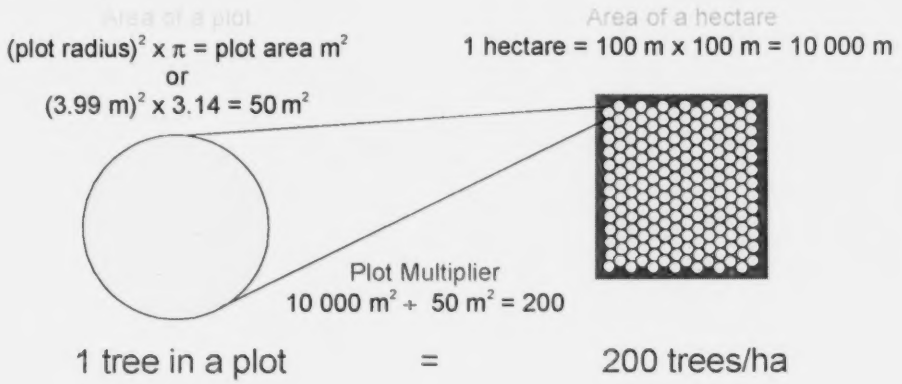

Area of a plot
(plot radius)² x π = plot area m²
or
(3.99 m)² x 3.14 = 50 m²
Area of a hectare
1 hectare = 100 m x 100 m = 10 000 m
Plot Multiplier
10 000 m² ÷ 50 m² = 200
1 tree in a plot
=
200 trees/ha

Figure 4. Plot multiplier concept.

For a complete range of possible plot radii and their associated areas and plot multipliers, refer to item number 5 on the FS 660 card.

3.5.1 M Value

The "M" in M value represents maximum. That is, the maximum allowable number of well-spaced or free growing trees that may be counted in a single plot. The M value is an integral part of the silviculture survey process and is essential to the determination of stocking status (not satisfactorily restocked [NSR], satisfactorily restocked [SR], or free growing [FG]). The M value, along with the minimum inter-tree distance and stratification criteria, provides the district manager with some measure of assurance that the regenerated stand is sufficiently consistent in its stocking distribution. The M value acts as a cap on the number of trees in a single plot that can compensate for low stocking in other plots.

The M value was one of the principles considered in the formulation of the stocking standards recommended in the *Establishment to Free Growing Guidebook*.

Consider the following extreme example:

Plot no.	No. of well-spaced trees in each plot	
	Without M	With M
1	11	6
2	11	6
3	11	6
4	1	1
5	1	1
6	1	1
Total	36	21
Average	6.0	3.5
Trees per hectare assuming 3.99-m plots	1200 trees/ha	700 trees/ha

Without the M value, overstocked plots would compensate for understocked plots. The result would be an unacceptable level of variation in stocking, or a "patchy" stand. When stands of equal densities are compared, we find that the stand with an even distribution produces more volume over a rotation than the stand with a patchy distribution.

3.6 Tallying Well-spaced and Free Growing Trees

3.6.1 Stocking Surveys

Tally, by species, the number of trees within the plot that meet all of the acceptability criteria and minimum inter-tree distance requirements, **including those that exceed the M value,** and record these in the appropriate species columns of the FS 658.

In the TOTAL W column, record the sum of preferred and acceptable well-spaced trees in the plot, up to the maximum per plot indicated on the FS 657 (M value). If the maximum is reached or exceeded, record the letter "M" rather than the numeric value.

Follow the arithmetic procedure on the FS 659.

The number of well-spaced trees per hectare disregarding the M value is reported on the Form C, FS 922, or FS 810A on the inventory label data row, in the well-spaced column.

3.6.2 Free Growing Surveys

Tally the number of free growing trees within the plot by species that meet all of the size, quality, minimum inter-tree distance, and vegetation free requirements, *including those that exceed the M value* and record in the appropriate species columns of the FS 658.

In the TOTAL FG column, record the sum of preferred and acceptable free growing trees in the plot, up to the maximum per plot indicated on the FS 657 (M value). If the maximum is reached, or exceeded, record the letter "M" rather than the numeric value.

In the TOTAL W column, record the sum of the all free growing and any additional well-spaced, but not free growing trees including those that exceed the M value. Do not record an M when the maximum number of trees per plot is reached—record the actual total.

Follow the arithmetic procedure on the FS 659.

The number of free growing trees per hectare disregarding the M value is reported on the Form C, FS 922 or FS 810A on the inventory label data row, in the free growing column.

3.7 Acceptable Tree Characteristics

Trees that contribute to stocking are the subset of all the trees in a plot that are most likely to form the managed portion of the new crop. Trees that contribute to stocking must be:

- the preferred or acceptable species listed in the silviculture prescription
- at least the minimum inter-tree distance, as specified in the silviculture prescription, from any other tree that is recorded as a well-spaced tree
- healthy
- individual forest districts may require well-spaced trees to be a minimum age and/or height
- growing on a suitable microsite

The provincial free growing damage criteria do not directly apply to well-spaced trees at the regeneration stage (i.e., before free growing declaration). It may not be realistic to apply all of the free growing damage criteria to well-spaced trees. Damage agents affecting well-spaced trees at the regeneration stage could still be affecting the same trees at the free growing stage.

For example, if mistletoe is found on the stem of a young tree, it will likely persist to the free growing age and beyond. This tree should not be accepted as well spaced. Unless a district, region, or licensee provides its own criteria for well-spaced trees, the final decision may be left to the surveyor's common sense. In this case the surveyor should document the rationale for the decision.

The primary function of counting the number of well-spaced trees present in stocking survey plots is to determine if more well-spaced trees are present per hectare within each survey stratum than are required by the minimum stocking standards in the silviculture prescription.

3.7.1 Free Growing

Free growing trees are the subset of well-spaced trees that are healthy, are free of excess vegetation and conifer tree competition, and can be expected to produce a commercially valuable crop. The assessment of free growing is conducted at the tree level and at the stratum level.

3.7.1.1 Tree Level

A free growing tree meets all of the criteria of a well-spaced tree and the following additional criteria:

- It is free of unacceptable levels of forest health damage. Refer to Appendix 5 in the *Establishment to Free Growing Guidebook*, Free Growing Damage Criteria Appendix 5 (sample link to the Prince Rupert Forest Region provided, all regions are identical).
- It is free of unacceptable levels of vegetative competition (herb, shrub, or broadleaf tree).
- It meets any criteria explicitly stated in the silviculture prescription for the area.

When conducting a free growing survey, maximize the number of free growing trees that meet the required crop tree/brush ratio using the minimum inter-tree distance. Determine if additional trees are well spaced but not free growing.

3.7.1.2 Stratum Level

At the stratum level, surveyors consider the following:

- Are there sufficient free growing preferred plus acceptable trees per hectare?
- If applicable, are there sufficient free growing preferred trees per hectare?
- Are there more than the maximum density number of countable conifers present?
- Has a brushing treatment been recently completed?

3.7.1.3 General Eras of Free Growing Standards

Definitions and specifications of the assessment of competing vegetation can be classified into three general eras:

- pre-1994 Silviculture Practices Regulation era
- post-1994 Silviculture Practices Regulation era
- two options era

3.7.1.3.1 Pre-1994 Silviculture Practices Regulation Era

The pre-1994 Silviculture Practices Regulation era dates from December 17, 1987, through February 7, 1994 (date of silviculture prescription approval). These older silviculture prescriptions have a wide range of specifications with regards to free growing definitions. Some do not specify the determination of free growing status. In this era, regions and districts specified methods of defining "free from unacceptable levels of vegetative competition."

Some of the differences are discussed in Forest Practices General Bulletin No. 27, *Enforceability of Free Growing Obligations on Pre-Code Prescriptions*. The bulletin divides this era into two periods based on the content of the original silviculture prescription.

3.7.1.3.2 Post-1994 Silviculture Practices Regulation Era

The post-1994 Silviculture Practices Regulation era (February 7, 1994, to spring 2000) is characterized by a consistent approach to free growing determination.

The effective growing space of a tree is defined as a 1 m radius cylinder around the tree. For a tree to be considered free growing, the tree must be at least the required height above the competing brush. The required height is expressed in the form of percentage conifer/brush ratio. The two most common conifer/brush ratios used in the province are 125% and 150%.

The Forest Practices General Bulletin No. 27, *Enforceability of Free Growing Obligations on Pre-Code Prescriptions*, is also a useful reference on this topic.

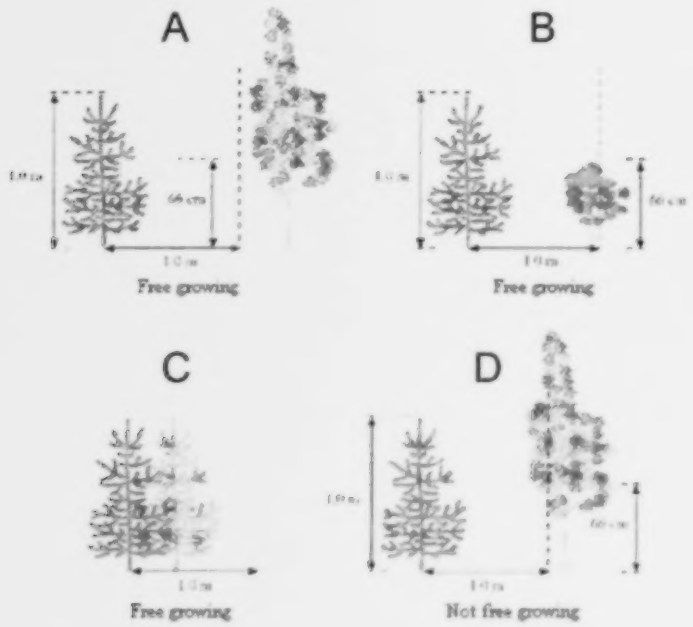


Figure 5. Examples of free growing determination.

In Figure 5, Example A, the crop tree is free growing because there is no vegetation within a 1-m radius. In Example B, the crop tree is free growing because the crop tree is 150% or more than the height of the tallest competing vegetation within a 1-m radius of the crop tree (66 cm multiplied by 150% is approximately 1.0 m.) In Example C, the crop tree is free growing because other conifers are not considered as competition at this stage. They are considered at the stratum level with maximum density. In Example D, the crop tree is not free growing because the crop tree is not 150% or more than the height of the tallest competing vegetation within a 1-m radius of the crop tree. *Any* encroachment of vegetation within the 1-m radius cylinder makes the crop tree not free growing. This may be as little as a single leaf or other relatively minimal vegetation.

3.7.1.3.3 Two Options Era

The document *Interim Free Growing Guidelines* was introduced in the spring of 1999, formalized in 2000, and incorporated into the *Establishment to Free Growing Guidelines*. At present, the licensee responsible for producing a free growing stand can choose one of two methods of assessing the level of

competing vegetation to determine the free growing status of the area being surveyed. Selecting components from a combination of the two methods is not permissible.

For Method 1, survey the opening based on the parameters specified in the silviculture prescription.

For Method 2, survey the opening based on the procedures for assessing competing vegetation described in Appendix 9 of each regional *Establishment to Free Growing Guidebook* (Cariboo Forest Region link provided).

This procedure requires that licensees accept a minimum height standard if one is not described in their current silviculture prescription when using the new "free from brush" guidelines.

None of the other criteria changes. Inter-tree distance, species acceptability, conifer/brush ratios, minimum height (if specified), minimum and target stocking standards, and others are still used as set in the silviculture prescription. Only minimum heights are added to "compensate" for reduced vegetation competition specifications.

It may be acceptable to some district managers to select separate methods for each Standards Unit within an opening. This should be pre-approved to avoid rejection by the district manager. See *Submission of Free Growing Reports by Standards Unit* (Forest Practices Bulletin No. 40) for more details on the subject.

3.7.1.4 Recording Unacceptable Species as Well-spaced or Free Growing

It is suggested to record well-spaced or free growing species that are performing well on the opening, but are considered unacceptable according to the silviculture prescription or to the specifications provided by the district manager.

The surveyor must always maximize the plot with the preferred and acceptable species before tallying any unacceptable species. The unacceptable species must be recorded and compiled separately to avoid any potential confusion with the preferred and acceptable species.

The intent of tallying unacceptable species is primarily for treatment recommendations. Tallying unacceptable species will also provide justification when recommending an amendment to allow the unacceptable species to be considered as an acceptable species on the opening. A surveyor should exercise caution when tallying unacceptable species, so that a block is not mistakenly declared stocked or free growing.

3.7.1.5 Maximum Density

If the silviculture prescription was approved on or after April 1, 1994, and the number of conifers per hectare exceeds 10 000,[1] the number of conifers must be reduced to within the range specified in the silviculture prescription before the completion of the free growing assessment period.

If the silviculture prescription was approved before April 1, 1994, the density must be reduced to within a range specified by the district manager, before the completion of the free growing assessment period if the density of lodgepole pine or drybelt Douglas-fir exceeds 10 000 per hectare (see footnote).

[1] The Silviculture Practices Regulation now makes provisions for the regional manager to specify other numbers using the guideline and chief forester's policy.

- In both of these time periods, trees that must be counted are
- those conifers that are taller than 20% the height of the median well-spaced trees in the survey plot; or
- layer 3 trees, (1.3 m tall to < 7.5 cm dbh) in single tree selection systems

The details of this province-wide change are described in a document entitled *Changes to Maximum Density Requirements in Silviculture Practices Regulation Section 13*.

3.7.2 Multi-storey Survey

The methods used to complete surveys on multi-storey stands are currently under revision. We recognize that the procedures in the *Correlated Guidelines for the Management of Drybelt Douglas-Fir* are no longer current and the procedures described in the *Silviculture Surveys Guidebook* (May 1995) require additional detail. The following may be interpreted as a rough draft of the process. The areas highlighted in yellow are likely to change.

The multi-storey survey procedures apply to stands that are being managed under a single tree selection silvicultural system. Multi-storey surveys are undertaken to ensure that the larger trees on an opening are recognized as having different attributes and growing requirements from the smaller trees growing on the same opening.

The objectives of a multi-storey survey are as follows:

- to collect data used to determine the stocking status
- to determine if the reforestation obligations prescribed in the silviculture prescription have been met
- to gather information necessary to make treatment recommendations
- to produce an updated map label and forest cover description

To be classified as multi-layered, a stand should meet the following criteria:

- The management intent of the silvicultural system is single tree selection.
- Each layer must be distinct and relatively homogenous throughout the type.
- The age and height differences should be both photo- and ground-identifiable.
- Each layer should consist of different tree species except when the layer separation is distinct.
- Differences in age and height between layers should be identifiable on the aerial photograph and on the ground.
- The bottom layer is usually established following a major disturbance such as fire or logging.
- The age of the younger of the two layers should be 120 years or less. If both layers are 121 years or older, the polygon should be treated as one layer.

A definition of multi-storey standards is also available at the Vegetation Resource Inventory Web site.

3.7.2.1 Multi-storey Stocking Standards

Pre-harvest silviculture prescriptions approved between October 31, 1987, and April 15, 1994, contain varying degrees of management objectives. Many pre-harvest silviculture prescriptions provide only even-aged stocking standards. If uneven-aged standards are not described, an amendment is recommended. Surveyors may survey multi-storey stands as such, even though the stocking standards on the silviculture prescription are not correct (see Figure 6). Surveyors should consult with the district regarding its policies in this situation.

The *Establishment to Free Growing Guidebook* (Cariboo Forest Region link provided) illustrates the conversion from even-aged to multi-storey stocking standards.

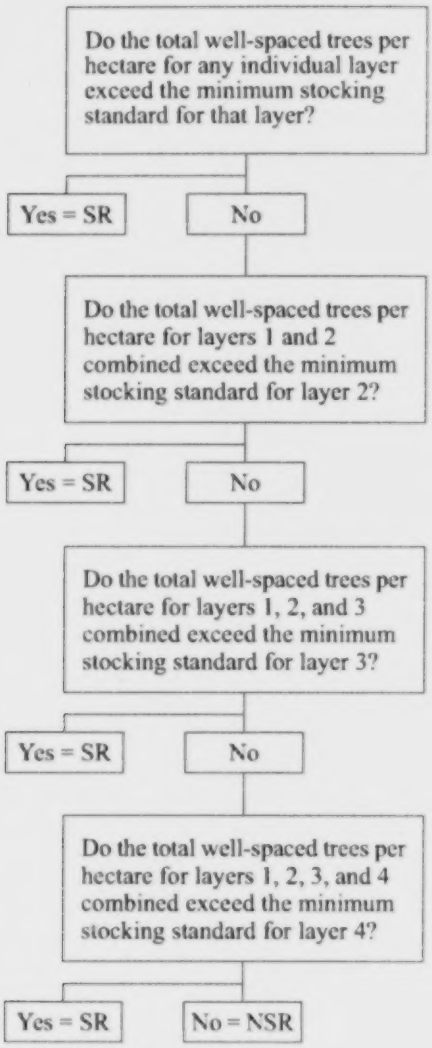

Do the total well-spaced trees per hectare for any individual layer exceed the minimum stocking standard for that layer?
Yes = SR
No
Do the total well-spaced trees per hectare for layers 1 and 2 combined exceed the minimum stocking standard for layer 2?
Yes = SR
No
Do the total well-spaced trees per hectare for layers 1, 2, and 3 combined exceed the minimum stocking standard for layer 3?
Yes = SR
No
Do the total well-spaced trees per hectare for layers 1, 2, 3, and 4 combined exceed the minimum stocking standard for layer 4?
Yes = SR
No = NSR

Figure 6. Stocking decisions for multi-storey surveys

3.7.2.2 Data Collection

Multi-storey stand assessment and data collection are more complex than those of an even-aged opening. The well-spaced or free growing trees within the plot should be tallied using the following guidelines:

1. Record the number of total trees and total conifers for each layer.
2. Tally, by species, the number of trees in layer 1 that meet all of the acceptability criteria, **including those that exceed the M value** and record these in the appropriate species columns of the FS 658. Layer 1 trees do not have a specified minimum inter-tree distance. In the TOTAL FG column, record the sum of preferred and acceptable free growing trees in layer 1, up to the maximum (M value) for layer 1.
3. Tally the total number of free growing trees in layer 2. Acceptable well-spaced or free growing trees in layers 2, 3, and 4 must be the minimum inter-tree distance from ALL acceptable layer 1 trees and from the SELECTED trees in the other layer above. Tally, by species, the number of trees in layer 2 that meet all of the acceptability criteria, **including those that exceed the M value,** and record these in the appropriate species columns of the FS 658. In the TOTAL FG column, record the sum of preferred and acceptable free growing trees in layer 2. This number when combined with the TOTAL FG column for layer 1 must not exceed the maximum (M value) for layer 2.
4. Tally the total number of free growing trees in layers 3 and 4. Follow the procedures in 3 above. In the TOTAL W column for layers 3 and 4, record the sum of all the free growing and any additional well-spaced, including those that exceed the M value.
5. Sample height and age data are collected at the first plot and at every fourth plot after that, by stratum and layer. Where few plots are established in a stratum, it is necessary to record a sample age more often than every fourth plot. Each stratum should have a minimum of three samples.
6. Conduct a prism sweep and tally the number of live trees that are greater than or equal to 12.5 cm in diameter measured at breast height (dbh), that are determined "in" using a prism (i.e., layer 1 trees). These trees may or may not be within the fixed-radius plot. If the silviculture prescription specifies approximate density by diameter class, then the surveyor must divide layer 1 trees into diameter classes, based on either ocular estimation or on direct measurements.
7. Determine the modal diameter and tally it in the row of data corresponding to layer 1. Modal diameter is the most frequently observed diameter of the layer 1 trees found within the prism sweep. Modal diameter is *not the average* diameter.
8. Record the first four letters of the genus, followed by the first three letters of the competing herbaceous, shrub, or brush species. Estimate the average percentage of the ground that is covered by the competing vegetation species. This is an ocular estimate of the competing vegetation percentage cover in and around the plot, not just within the plot. Measure the average height (n centimeters) of each of the competing vegetation species. This is an ocular estimate based on the average height of the competing vegetation in and around the plot, not just within the plot.
9. Record the applicable pest code of the forest health factor on each affected tree, by layer, within the plot. Forest health data are collected at every plot. If two forest health factors are on the same tree, only one is recorded. The one to record should be the one with the more detrimental effect. Refer to the *Damage Agent and Condition Codes FS 747* for a comprehensive list of forest health factors and their corresponding pest code.
10. A description of the inventory component is collected, by layer, at the first plot and at every fourth plot after that, by stratum. Species composition to the nearest 10% is based on basal area for layers 1 and 2 and density for layers 3 and 4. Age and heights are estimated for the dominant and co-dominant trees in each layer. Site index should be determined using suitable candidate trees.

Where few plots are established in a stratum, it would be necessary to record the inventory label data more often than every fourth plot. It is recommended that a minimum of 12 inventory labels, three per layer, be collected in each stratum.

3.7.2.3 Basal Area (BA)

Basal area is the cumulative cross-sectional area, represented in square metres (m^2), of the live trees that are greater than or equal to 12.5 cm in diameter, measured at breast height, as determined to be "in" by using a prism (i.e., layer 1 trees). Basal area must be collected by species where the silviculture prescription specifies basal area by species and by diameter class. It is a legal requirement to collect basal area data if the stocking standards in the silviculture prescription require that a specific basal area per hectare be retained after harvest. If the silviculture prescription does not stipulate the planned residual basal area per hectare to be retained after harvesting, the surveyor is not legally required to collect basal area data. It is recommended, however, that the surveyor collect these data during the survey, as they may assist in developing treatment recommendations. Refer to Appendix 4

Further details on determining basal area can be found in any text covering forest measurements, including Luttmerding et al. (1990) and *Vegetation Resource Inventory – Ground Sampling Procedures*.

3.7.3 Dispersed Types

In some cases, the strata on an opening may be better described by their characteristics rather than by their geographic location. Some openings have distinct strata that occur in a dispersed manner, also known as "mosaics."

Although these dispersed strata should be identified in the silviculture prescription, they have historically not been specified. Therefore, where an opening is best described as dispersed strata, an amendment to the silviculture prescription may be required.

Dispersed strata:

- have distinctively different characteristics that can be clearly described; and
- have occurrences of each stratum that are impractical to map (too small, too numerous, and/or too inter-mixed).

The following methodology is used to sample dispersed strata:

- Clearly define the characteristics of each stratum.
- Establish the number of plots in each stratum that are required to meet the desired statistical precision. Plots may have to be moved to ensure that they are fully located within a stratum. If a grid pattern sampling design is used, plots should be moved along the strip line in increments of 10 m until the plot falls fully within one of the strata.
- Estimate the proportion of the opening that is representative of each stratum.
- Summarize the data for each stratum separately.
- Record stratum labels on the map (Figure 7).

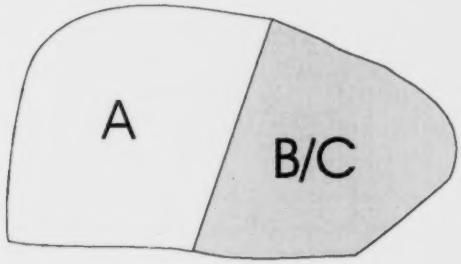


Figure 7. An example of dispersed strata map label.

The determination of the area represented by each stratum is relatively complex (Table 2). Area is expressed as a percentage of the combined total area of the dispersed strata. Area can be determined by:

- visual estimate
- photo interpretation
- line intersect
- high intensity point sampling

Visual estimates or photo interpretation are the most simple, but also the least accurate.

Table 2. Example of a dispersed strata area calculation

Stratum		Proportion of area represented by each stratum	Area (ha)
A		n/a	8
B	Combined area 10 ha	60%	6
C		40%	4
		Net area to be reforested	18

3.8 Walk-through

A walk-through is an initial reconnaissance of the opening. One of the most effective ways of conducting the walk-through is to physically walk through the opening, visually noting the characteristics found on the opening. The process can often be mechanized via all terrain vehicles and aircraft. The walk-through is used to confirm a variety of site and survey decision information, including:

- stratification
- definition of dispersed strata
- ecological classification
- survey objectives
- sampling intensity required for each stratum
- a preliminary assessment of forest health factors present
- identification of the leading inventory species

- method of determining site index
- consideration of potential treatments
- identify limiting factors
- for multi-storey surveys, the basal area factor to be used (prism size)

3.8.1 Stratification

The walk-through is used to modify the preliminary stratification before gathering data.

Without proper stratification, the survey results will not be representative of the target population being sampled. For example, if a not satisfactorily restocked (NSR) area was not stratified separately from a satisfactorily stocked (SR) area, the entire opening may be incorrectly declared SR or NSR because of the averaging of the two distinct populations. The survey may also be considered inconclusive because the sampling error would be higher than necessary.

To meet the requirements of the silviculture prescription, it is essential to stratify first based on the Standards Units in the silviculture prescription. Subsequent stratification within Standards Units is based on changes in:

- biogeoclimatic zone site series, where the site series identified have different stocking standards
- stocking status (NSR, SR, FG)
- the leading species (for example, Fd_8Ss_2 vs. Ss_7Cw_3)
- the inventory species composition, when there is a change greater than 20% in the leading species (for example, Pl_9Sx_1 vs. Pl_6Sx_4)
- age, into a different age class
- height, into a different height class
- crown closure, when there is a change greater than or equal to 20%
- previous treatments and history[2]
- stand structure (even-aged vs. multi-storey)
- forest health factors
- recommended treatments

Stratification is the most critical step in the survey process. Stratification defines and identifies populations with similar characteristics within an opening. The objective of stratification is to increase sampling precision by delineating homogenous strata within an opening, so that there is less variation within each stratum than within the entire opening. Stratification is used to increase the efficiency of the survey by reducing the number of plots required per stratum to reach a desired sampling precision. Stratification can also improve the reliability of the treatment recommendations.

[2] Not all previous treatments need to be considered as separate strata. Treatments that result in strata that have similar characteristics at the time of the survey should be considered as one stratum. For example, suppose that half of an opening was drag scarified, and the other half left untreated. If both halves have similar characteristics at the time of the survey, this component of history may be ignored for the stratification. This might occur, for instance, if previous successful brushing or spacing treatments have removed the original differences between the two halves.

Stratification is required to meet the legal requirements specified in the silviculture prescription. All silviculture prescriptions contain one or more Standards Units that are developed according to biogeoclimatic classification, site attributes, and stand management objectives. If more than one Standards Unit is defined in the silviculture prescription, these Standards Units must be stratified and surveyed separately.

These Standards Units are further subdivided based on the characteristics discussed previously in the walk-through section.

Two examples are presented to compare the significantly different survey results that are produced from correct stratification. Figure 8 depicts the results of an unstratified survey for a sample opening. Figure 9 demonstrates the results of correct stratification for the same opening.

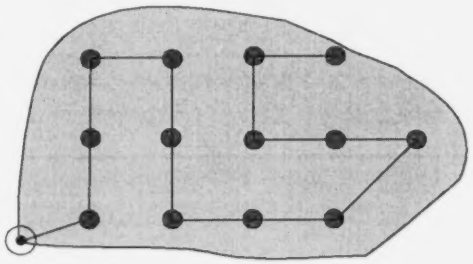


Figure 8. Systematically positioned plots without stratification.

Well spaced	750 trees/ha
Minimum stocking standard	700 trees/ha
Confidence interval	200 trees/ha
Recommendation	establish more plots or fill plant

The results of this survey without stratification are inconclusive.

After a thorough file review, preliminary stratification, and walk-through, two strata were identified and sampled separately. The data from the 13 plots indicate the following results:

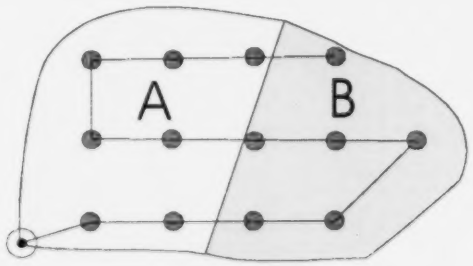


Figure 9. Systematically positioned plots after pre-stratification.

Stratum A		Stratum B	
Well spaced	1000 trees/ha	Well spaced	500 trees/ha
Minimum stocking standard	700 trees/ha	Minimum stocking standard	700 trees/ha
Confidence interval	75 trees/ha	Confidence interval	70 trees/ha
Recommendation	sufficiently restocked	Recommendation	fill plant

The results of the correctly stratified survey are more likely to provide definitive results, and describe the condition of the current opening.

3.8.1.1 Definition of Dispersed Strata

When the walk-through identifies strata that are so distinctly different, but so intimately mixed that it is impractical to map the location of each portion of the strata, these can be surveyed as dispersed strata. During the walk-through, the characteristics of each of the strata must be clearly and distinctively defined for application during the field data collection.

3.8.1.2 Ecological Classification

During the walk-through, the surveyor is responsible for re-evaluating the accuracy of the ecological classification of the survey area. The classification completed during the preparation of the silviculture prescription can be used as a likely reliable starting point, but should not be assumed to be perfect.

3.8.1.3 Survey Objectives

The questions posed and the data needs identified while considering the survey objectives during the office review should be "fine tuned." Once on site and after viewing the survey opening, the objectives identified may have to be modified.

3.9 Selecting a Sampling Method

Generally, we sample where it is too time consuming to complete a full inventory. In the case of silviculture surveys, the time required to count every tree in a stratum is excessively costly compared with the relative accuracy required. As a result, we collect data from a relatively small number of small sample plots, then average the data and extrapolate the information over the entire stratum.

The establishment of plots is the basis for the statistical methods used in the survey. The requirement for a systematic pattern has often been stressed as important to the integrity of the sampling method. Contract clauses often include phrases such as "plots must be uniformly located throughout the opening." There is no statistical reason for the plots to be "well distributed" and "uniformly and proportionally located throughout the opening" as long as the stratification has been correctly completed.

Statistical principles require that all potential plots in the survey area have an equal chance of being selected. *The purpose of random locations for the plots is to ensure that the collected data is not "biased."* For instance, plots on rocky outcrops or in thick brush will be as likely be chosen as plots in "farm-field" spots.

The systematic sample may result in a biased sample if, for instance, the plots more often than not landed on skid roads because the spacing was similar to the skid road layout. A systematic layout with a random start is an attempt to reduce this bias but it is still a possibility. The skillful surveyor will look for potential sources of bias in plot location.

3.9.1 Sampling Principles

Silviculture surveys are based on two primary sampling principles:

11. identify strata
12. gather data that are representative of each stratum

Many sampling methods and plot intensities can produce valid results to meet the second primary sampling principle, but they will only withstand an inspection if stratification, the number one principle, has been done correctly.

The Silviculture Practices Regulation requires that a survey completed on or before the regeneration date in the silviculture prescription and the submission of specified forest attributes, but does not require a specific survey method or intensity of survey. The survey must be carried out to the satisfaction of the district manager. The survey estimates of the required attributes would need to be within the range of estimates derived using the Ministry's survey system as described in the *Silviculture Surveys Guidebook*. Therefore, gathering the required attributes by visual assessment or other means may be acceptable. During a Ministry audit or inspection, the Ministry's system would be used.

3.9.2 Plot Intensity and Design

Many believe that any method other than the structured grid pattern results in unacceptable results. This is not true. Remember that a survey is only a sampling process, not a complete inventory of strata. It also relies on the completion of the walk-through and thorough stratification first, followed by a sampling of the resulting strata, and, last, an analysis of the statistical reliability of the data collected. The surveyor should select the method of sampling, and the number of samples collected based on the homogeneity of the stratum.

Surveyors are expected to select the most appropriate survey method and intensity to adequately sample the characteristics of individual strata. Regardless of the sampling pattern used, the results should be significantly similar. If they are not, then the selected method may not have been appropriate.

When selecting a sampling method and design, the complexity of the stratum being sampled should be considered. Homogeneous populations can be adequately sampled with few plots and with less structured sampling design. Three sampling designs are discussed in the following sections, but other equally valid methods may also be applied.

3.9.2.1 Grid Pattern

The grid pattern method's greatest application is in strata that are heterogeneous—strata with a great deal of variability even after thorough stratification has been completed.

Although one plot per hectare on a grid pattern is commonly used, this sampling intensity is often excessive. The result is a survey that is far more expensive than necessary.

The grid pattern method is effective where many plots are required in a stratum (Figure 10). The grid pattern results in a more predictable plot location as long as bearing and distance measurements are taken carefully. This method also facilitates mapping of stratum boundaries and other within-block features.

Plots are positioned at equal intervals along predetermined strip lines. A baseline may be used to maintain the integrity of the grid pattern over longer distances. The top right example shows an offset grid pattern that is also acceptable.

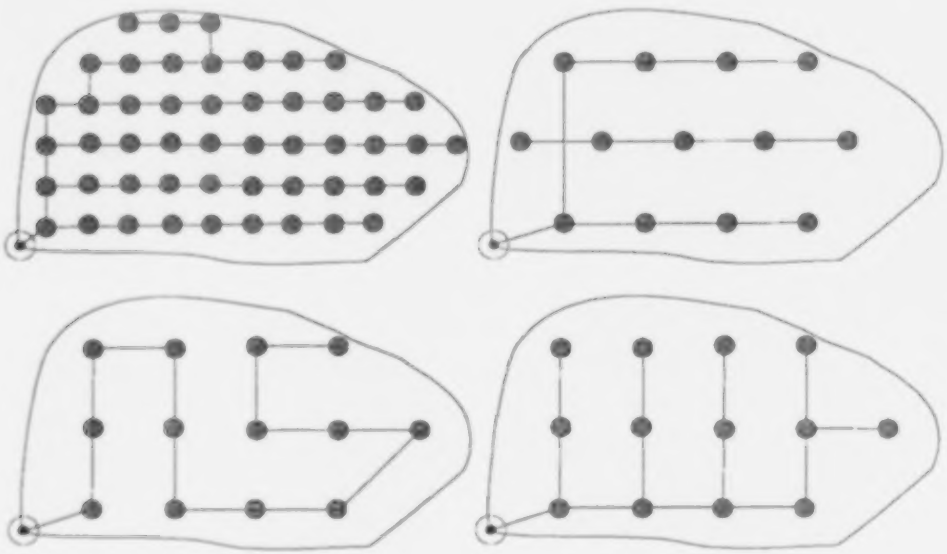


Figure 10. Examples of locating plots on a grid pattern.

3.9.2.2 Representative Sampling

Representative sampling is a survey method that may initially be considered to be a very biased method. It can be, if not completed by surveyors with a great deal of experience, skill, and integrity. It is *not* well suited for use on legally required stocking and free growing surveys. It is especially well suited for the non-mandatory, intermediate surveys often completed by licensees to assess the progress of a stand towards its desired condition.

The surveyor travels through the stratum, visually evaluating the characteristics of the stratum. Plots are established in any location in which the surveyor believes "a plot in this location would generate results that will describe the characteristics of the stratum" (Figure 11).

Plots located anywhere within the stratum are equally valid samples as long as the stratification has been thoroughly completed, and the plots are not positioned with an intent to change the survey outcome.

Figure 11. Example of locating plots using representative sampling.

3.9.2.3 Plots Located on a Vector(s)

This method is best used in small, narrow, and irregularly shaped strata. It also lends itself well to surveys that required lower plot intensities.

To establish plot locations when one plot per hectare is not applicable or required, calculate the total length of the strip that would evenly and adequately sample the opening and divide the total length by the number of plots required. The total length of the strip line is a combined total of all of the strip lines, regardless of bearing (Figure 12).

1. Based on the variability of the strata, as found during the walk-through, estimate the number of plots to adequately sample the stratum.
2. Draw a desired sample strip line pattern on the map of the stratum. Measure the total length and bearing for each line segment. (A single line should be limited to very small strata.)

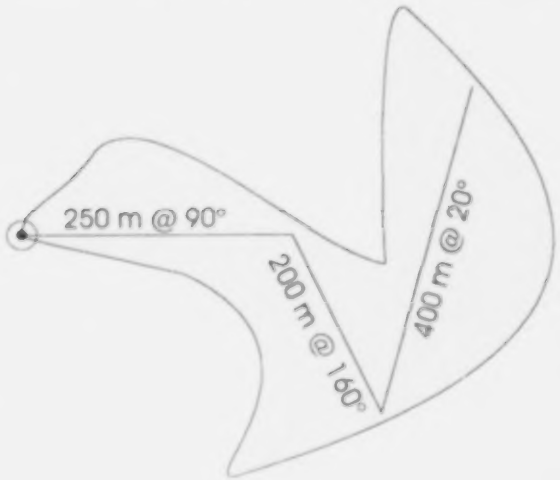


Figure 12. Example of bearing and distance for plots along vectors.

3. Divide the total length of the lines by the number of plots required to calculate the distance between plots along the line. Rounding this value will make the field application of the method easier without affecting the results. In the example in Figure 13, 850 m ÷ 6 plots = 141.6 m, or 142 m.

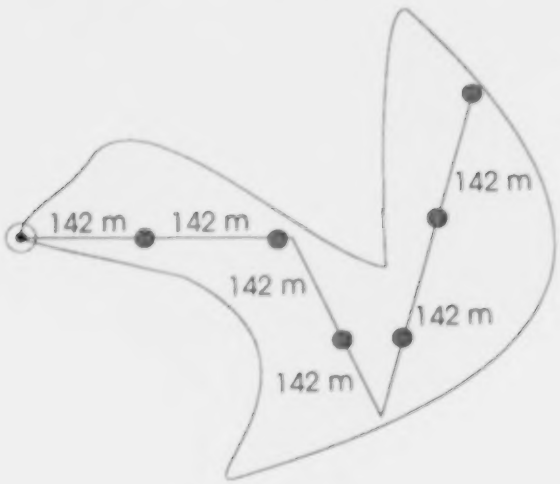


Figure 13. Example of locating plots along vectors.

3.9.3 Multiple Sample Designs in an Opening

The methods for plot positioning and for sampling intensity are often different in each of the strata within a single opening. Figure 14 depicts stratum A using a grid plot location method starting from a randomly selected starting point. The high level of sampling intensity may have been selected because of the patchy nature of the stocking identified during the walk-through.

Stratum B uses a representative method of plot location as well as a low level of sampling intensity. This method and intensity may have been selected because the area was not yet eligible for a free growing survey whereas stratum A was (i.e., strata have different early free growing dates) and to reflect the very consistent level of stocking on stratum B. The statistical analysis would subsequently have a small confidence interval.

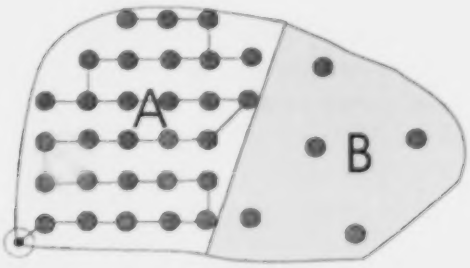


Figure 14. An example of sampling methods that vary by stratum.

3.9.3.1 Preliminary Assessment of Forest Health Factors

The walk-through provides an opportunity for the surveyor to wander through the opening with the freedom to investigate anomalies within the stand. The surveyor should not adhere to a predefined route.

but rather vary the route to inspect those trees with unusual colour or form. Forest health factors that are more difficult to identify can often be identified more easily after observing a number of them. Those found during the walk-through are likely to be found in the sample plots as well. It is these observations that are recorded on the back of the FS 657 field card.

The subject of forest health as it relates to free growing surveys is also discussed in *Evaluation of Forest Health in Free Growing Assessments* (Forest Practices Bulletin No. 34).

3.9.3.2 Leading and Second Species for Inventory Label

Inventory labels are generated based on a series of visual observations. The process requires the surveyor to gather species composition estimates as well as the age and height for the leading and second species. It is therefore essential to determine the most common, and second-most common species within the stratum before collecting age and height measurements. It is especially important to coordinate where more than one person is gathering data on the same stratum.

3.9.3.3 Site Index

Site index is a measure of the growing potential of a site. Site index is defined as the average top height of trees, of a certain species, at 50 years breast height age.

Accurate site index values are required for inventory, timber supply analysis, and silviculture decision-making. In silviculture, site index is often used to select or rank sites for treatment, to prescribe appropriate treatments, and to schedule these treatments. The Silviculture Practices Regulation, Sections 25, 26, and 28 requires site index to be determined as part of the survey and to be reported on Form C submissions. Site index is also a mandatory field requirement in ISIS and must be entered into forest cover screens after all silviculture surveys, usually through the FS 810A or FS 922.

A complete discussion on site index determination can be found at:
http://www.for.gov.bc.ca/hfp/pubs/sicourse/index.htm or in the Ministry of Forests publication *Site Index Estimate by Site Series*.

3.9.3.3.1 Site Index Determination Method

During the walk-through, a surveyor must decide which method will be used to determine the site index for each stratum.

Five methods are used to determine site index: growth intercept, SIBEC (site index by biogeoclimatic classification), site index curves, site class conversion, and professional interpretation. These methods differ in their accuracy and availability, and in the input data required. It is always preferable to use the most reliable site index determination method that is available. A key to assist surveyors in selecting the most reliable method to use for estimating site index is provided on the FS 660. Normally, the leading species in the stratum's inventory label is chosen as the site index species. However, leading species in the inventory label is not always an appropriate choice for site index species when it is:

- silviculturally unsuitable (not a preferred or acceptable species)
- suppressed, damaged, or diseased

When the leading species of the inventory label is not the appropriate choice for determining site index, the leading species of the silviculture label should be chosen for the site index species.

The Silviculture Practices Regulation, Section 25 requires that site index be provided in both the inventory and silviculture labels. If these two labels have different leading species, two different site index values may be required.

Each of the site index determination methods has an approved abbreviation. These abbreviations are listed in the ISIS user guide.

3.9.3.4 Potential Treatments

While completing the walk-through, it often becomes apparent to the experienced silviculture surveyor that a specific treatment will be required. As a result, additional data can be collected during the survey that will provide a more precise prescription for the subsequent treatment. For example, if few trees are identified during the walk-through, planting may be required. Therefore, the surveyor should take the extra time required to collect the additional data required to complete a planting prescription. The same can be said for anticipated site preparation, brushing, and spacing treatments.

3.9.3.5 Minimum Stratum Size

Section 70 of the *Forest Practices Code of British Columbia Act* requires that a free growing stand be established "on those portions of the area under the prescription that are within the net area to be reforested" (NAR). Therefore, the stand must exist on that whole area and whatever portion of the area is measured must meet the minimum number of well-spaced or free growing stems per hectare.

Discretion must, however, be applied, and the following factors should be considered:

- management objectives for the block
- previous stand characteristics
- operational feasibility, including configuration of the stratum
- biological practicality, including productivity of the site
- cost, benefit, and risk

Guidance in minimum stratum size is also provided in the *Free Growing Declaration and Acknowledgement* (Forest Practices Bulletin No. 39).

Confirm the minimum stratum size expectations before completing any survey. The district manager may establish specific minimum stratum sizes for particular types of surveys (e.g., stocking vs. free growing).

4 Basic Field Procedures

For all silviculture surveys, several basic field procedures exist.

4.1.1 Tie Points and Points of Commencement

The point of commencement (P.O.C.) is the beginning or starting point of the survey. A point of commencement may be required for the random sampling method.

All tie points and points of commencement should be tied into easily identifiable features indicated on a map or on an aerial photo (e.g., road junctions, creek crossings, creek junctions, or block boundaries).

4.1.2 Marking Plots

Plot centres must be marked on the ground in such a way that they may be relocated for monitoring or auditing (Figure 15). If the ground is frozen or very rocky and a shovel or stick cannot be used for a plot centre, a comment should be made on the back of the FS 657 card or the bottom of the FS 658 indicating what was used for the plot centre. For example, the point on the ground directly below the flagging tape hung on a branch was used as the plot centre for plot 5.

Method B should only be used if it will not bias the results of the survey plot. Method D should be limited to areas with low slash and vegetation (e.g., plantability surveys).

A	B	C	D
Tied to a branch and in the shovel slit at plot centre	Tied to a branch and tied loosely at the base of the tree used for plot centre	Tied to a branch and tied to a stick pushed into the ground at plot centre	Tied to a stick and in the shovel slit at plot centre

Figure 15. Examples of plot marking methods.

In all cases, the plot is marked in two places with flagging tape/ribbon:

1. at approximately 1.3 m or higher, to allow for easy identification of the location of the plot; and
2. at the exact location of the centre used to measure the plot radius.

Some survey contracts specify that if the contract inspector cannot find the plot, it will be assumed to have not been established.

4.1.3 Strip Lines

Strip lines are often used in association with the grid pattern method. Strip lines are oriented to run up and down hills, thus crossing contour lines and the ecological strata that are often associated with changes in elevation. This allows the surveyor to verify eco-stratification boundaries. Using strip lines should ensure that each stratum is evenly sampled and that the plots are well distributed. Strip lines should be marked in the field.

Where the sampling intensity varies across strata, strip lines and/or inter-plot distances may also have to be varied.

4.2 Miscellaneous Concepts Related to Survey Standards

4.2.1 Ghost Trees

Ghost trees are trees that are left for non-timber values. They do not contribute to the stocking status of the stratum, but they do occupy growing space. This can impact the development of the regeneration. Ghost trees should be identified in the silviculture prescription as being reserve trees and their specifications (i.e., density, distribution, and rationale) should be described. If a silviculture prescription does not exist, or it does not address trees that have been reserved, then surveyors should consult with their contract supervisor for further direction.

The concept and definition of ghost trees are currently under reconsideration.

4.2.2 Veterans (Vets)

A veteran (vet) is a living remnant of a former stand. When used in the context of inventory labels, vets must have a combined crown closure of less than 6%, and must be at least 40 years older and 10 m taller than the main stand.

In districts still using the Forest Inventory Planning (FIP) database, vets can still be called a separate layer. In districts using the Vegetation Resources Inventory and INCOSADA, vets are no longer considered a separate layer, and should be included in layer 1.

It is likely that the term "vet" will not be used in the near future.

4.2.3 Advance Regeneration

Advance regeneration is defined as trees that are present on an opening that were established on the area before the disturbance that created the opening. They may make up all, part, or none of the reforestation obligation. They may also be present on the opening as part of a strategy to increase biodiversity or to maintain visual quality objectives.

These trees may only be tallied as well-spaced and/or free growing trees if they meet the criteria specified in the silviculture prescription.

Where acceptability criteria have not been included in the silviculture prescription or where there are no regional guidelines, consult Appendix 10 of the *Establishment to Free Growing Guidebook*.

4.2.4 Openings without Regeneration Objectives, Subject to Intermediate Cuts

Openings without regeneration objectives are most often areas of commercial thinning. For openings without regeneration objectives, the Silviculture Practices Regulation requires a survey to be completed more than 12 months after the completion of harvesting. The survey enables the district manager to determine that the requirements of the silviculture prescription have been met.

4.2.4.1 Commercial Thinning Survey Procedures

Most of the survey components for the commercial thinning survey are the same as for other forms of silviculture survey. Stratification is completed for all of the reasons applied to other silviculture surveys, with a few notable differences:

- identification of gaps
- determination of plot method (prism or fixed radius)
- number of sample trees
- site index method
- forest health damage criteria for scars
- data collection in 5 cm diameter classes

Identification of gaps in the stocking is particularly important—because there is no intent to regenerate the opening, existing gaps will persist to the next harvest. The walk-through should pay particular attention to gaps, or voids produced during commercial thinning operations.

During the walk-through the surveyor will have to determine the form of sample plots that will be established. If during the walk-through it is determined that 4–8 trees will be found in each of the prism sweeps using a basal area factor (BAF) 5 prism, then prism plots should be used to survey the stand. The plots should be measured carefully as they would be during timber cruising.

If less than 4–8 trees would be found, on average, in the BAF 5 prism plots, then fixed-radius plots should be used. Based on Table 3, the plot radius is selected to ensure the survey plots will identify 6 or more crop trees in each fixed-radius plot.

Table 3. Relationship between plot radius and crop tree densities

Estimated crop tree density (trees/ha)	Fixed-radius plot (m)
> 1200	3.99
900–1200	5.05
600–899	5.64
350–599	6.31
< 350	7.98

A minimum number of 5 crop trees should be sampled for their age and height rather than the minimum 3 used during other stocking and free growing surveys.

Site index will usually be determined using the site index (height/age) curve method, because the stand will likely be taller than can be surveyed using the growth intercept.

The forest health damage criteria have been adjusted to reflect the known harvesting damage potential in commercial thinning as well as the older nature of the candidate stands when compared with the typical free growing stand upon which the free growing damage criteria are applied. Individual wounds may have a maximum size of 400 cm^2 (20 × 20 cm). Multiple wounds may have a maximum cumulative area of 900 cm^2. Any single wound may not extend more than one-third of the circumference of the crop tree.

The plot data to be collected are similar to a pre- and post-stand tending survey; data are collected in 5 cm diameter classes.

Where an experienced surveyor is confident during the walk-through that there are no concerns present, the visual assessment survey method may be a suitable alternative to formal plot establishment.

4.2.4.2 Report Contents

The Silviculture Practices Regulation requires that a report that provides the following information be submitted to the district manager:

- identification of the area under the silviculture prescription
- the agreement and name of the holder of the agreement (where applicable)
- for the net area to be reforested:
- area
- biogeoclimatic ecosystem classification
- incidence of forest health
- inventory label, including species component, age, height, density, basal area, and site index
- number of preferred and acceptable trees per hectare

5 Use of the Ministry of Forests Survey Cards

While the use of the standard Ministry of Forests survey field cards and forms is not mandatory, they do allow for the following:

- organized collection of data required to meet the reforestation obligations of the silviculture prescription
- standardized data recording
- standardized data compilation
- standardized data summaries
- easily compared survey results

If you choose to use forms other than those provided by the Ministry of Forests, it is prudent to consider the data needs of the district manager. The most commonly used forms are highlighted in yellow in Appendix 9.

Standard Ministry of Forests field cards and forms are available from http://www.for.gov.bc.ca/pscripts/ISB/FORMS/forms.asp.

5.1 Setting Survey Parameters

Because most openings that will be surveyed have silviculture prescriptions prepared for them, identifying survey standards is as simple as searching through the silviculture prescription to locate the relevant stocking standards and transfer these to the appropriate fields on the various plot cards.

For openings where there is no silviculture prescription, the district manager is responsible for providing the survey parameters. In practice, this requires a consultative process between the person(s) and organization(s) concerned with the openings and often the services of a professional forester.

5.2 Silviculture Survey Card (FS 657)

5.2.1 Data Field Descriptions (Front of FS 657 Card)

Information to complete the front of the Silviculture Survey FS 657 card will generally be obtained by reviewing the silviculture prescription, ISIS, and the opening files. All information obtained during the office review must be confirmed during the walk-through.

The following pages comprehensively describe the information to be recorded on the Silviculture Survey FS 657 card. The Silviculture Survey FS 657 card (Figure 16) has a number in each field. This number corresponds with the following list of the fields.

Where a field is not applicable to a particular stratum, it is a common convention to mark the field with a dash ("–") to signify that the field was considered and not forgotten.

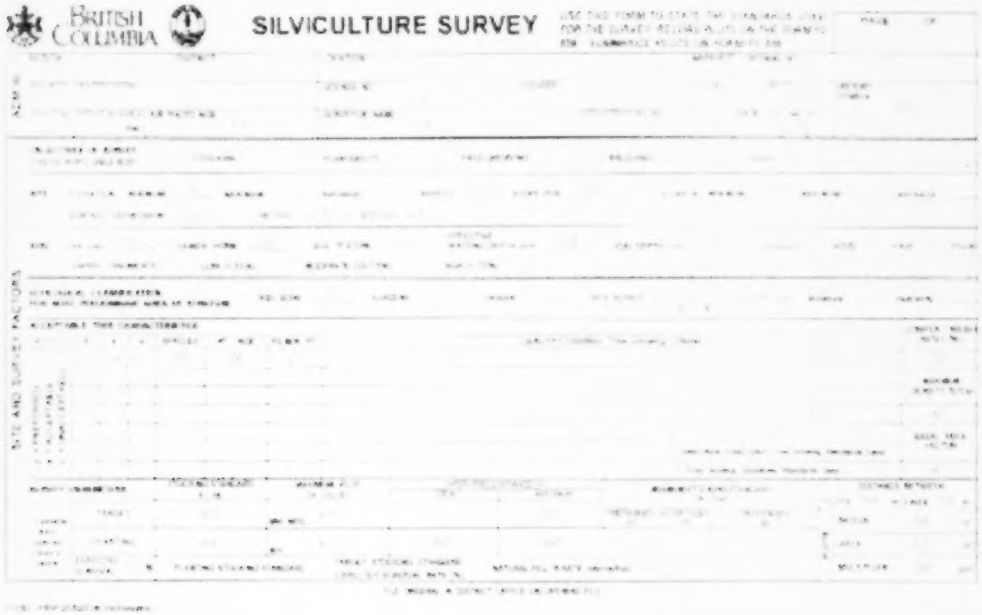


Figure 16. FS 657 Silviculture Survey card.

1. **Region:** Record the name or code of the region. This information can be located in the silviculture prescription, opening file, or contract, or from local knowledge. A map of the forest regions can be consulted. (See also region and district codes.)
2. **District:** Record the name or code of the district. This information can be located in the silviculture prescription, opening file, or contract, or from local knowledge. A map of the forest districts can be consulted.
3. **Location:** Record the general location of the opening. This information can be located in the silviculture prescription, forest cover map, opening file, contract, or from local knowledge. It should match any existing description, or be corrected if the current location is misleading.
4. **Mapsheet/Opening No.:** Record the mapsheet and opening number of the opening. This information can be located in the silviculture prescription, in the opening file, or on the forest cover map. The complete opening number is made up of both the mapsheet number and the opening number.
5. **Project Identification:** Record the specified project identification number or contract number. This information can be located in the survey contract.
6. **Licence No.:** Record the licence number assigned to the opening. This information can be located in the silviculture prescription or in the opening file.
7. **Licensee:** Record the name of the major tenure holder of the opening. This information can be located in the silviculture prescription or in the opening file. If a SBFEP timber sale, enter SBFEP.
8. **CP No.:** Record the cutting permit number assigned to the opening. This information can be located in the silviculture prescription or in the opening file.
9. **Block:** Record the cutblock number assigned to the opening. This information can be located in the silviculture prescription or in the opening file.

10. **History Symbol:** Record the history of the opening by using the symbols described on Table 4. The last two digits of the year of the treatment are to be recorded beside the code letter. This information can be located on the forest cover map, in ISIS, or in the opening file.

Table 4. History symbols

Class symbol	Code	History or treatment
Disturbance	B	Wildfire
	BE	Escaped Burn
	BG	Ground Burn
	BR	Range Burn
	BW	Wildfire Burn
	D	Disease
	F	Flooding
	I	Insect
	K	Fume Kill
	L	Logging
	L%	Logged (10% increments)
	R	Site Rehabilitation
	S	Slide
	W	Windthrow
Regeneration	P	Planted
Stand Tending	F	Fertilization
	H	Hack and Squirt
	J	Juvenile Spacing
	M	Mistletoe control
	P	Pruning
	R	Conifer Release
	S	Sanitation Spacing
	T	Commercial Thinning
	W	Brushing and Weeding
Site Preparation	B	Broadcast burn
	C	Chemical
	G	Grass Seeded
	H	Hand Preparation
	RB	Range Management Burn
	S	Spot Burn
	M	Mechanical
	MS	Mechanical and Spot Burn
	W	Windrow

11. **Stratum:** Record the stratum label assigned to the area surveyed. Capital letters, numbers, or a combination of both is acceptable.
12. **Stratum Area (ha):** Record the net area of the stratum.
13. **Air Photo Nos.:** Record the appropriate air photo numbers for the opening. This information can be located on the air photo that provides coverage of the block, or on a flight line key map that covers the survey area.
14. **Surveyor Name:** Record the name of the person(s) who completed the survey.
15. **Registration No.:** Record the silviculture surveyor accreditation number of the surveyor(s) who completed the survey. The Ministry of Forests assigns surveyor accreditation numbers to surveyors who have passed the silviculture survey accreditation exam.
16. **Date:** Record the date in which collection of survey data in the field was completed. Use the metric date: yyyy-mm-dd.
17. **Objectives of Survey:** Check the box next to the applicable survey that was completed. Frequently, more than one survey objective will be checked, as surveyors regularly do a combination of surveys at the same time.

    The stocking and free growing surveys cannot be combined because crop trees are tallied differently. Selecting the plantability objective (with or without the stocking or free growing objective) will require additional survey parameters (see Fields 46–49 and 52, 53).
18. **Elevation:** Record the minimum, maximum, and average elevation of the stratum in metres above sea level. This information can be located in the silviculture prescription, in the silviculture prescription field card, in ISIS, or on topographical maps. Elevation should be confirmed by contour map, by altimeter, or by GPS during the walk-through.
19. **Aspect:** Record the direction toward which a slope faces for the stratum. This information can be located in the silviculture prescription, on the silviculture prescription field cards, or in ISIS. Aspect, which must be confirmed during the walk-through, is recorded based on information in Table 5.

    All three of the columns are acceptable methods.

Table 5. Aspect and associated abbreviations

Description	Abbreviation	Approximate range of bearings
North	N	337.5 to 22.5°
North East	NE	22.5 to 67.5°
East	E	67.5 to 112.5°
South East	SE	112.5 to 157.5°
South	S	157.5 to 202.5°
South West	SW	202.5 to 247.5°
West	W	247.5 to 292.5°
North West	NW	292.5 to 337.5°
Flat	F	No identifiable aspect, associated with 0% slope
Variable	V	No consistent aspect, associated with rolling and broken topography

20. **Slope Pos.:** Record the position for the slope of the stratum. This information is recorded as crest, upper slope, middle slope, lower slope, toe, depression, and level, as described in Figure 1 on the FS 660 card. This information can be located in the silviculture prescription or on the silviculture prescription cards. Slope position should be confirmed during the walk-through.

21. **Slope %:** Record the minimum, maximum, and average slope percentage of the stratum. This information can be located in the silviculture prescription, or on the silviculture prescription cards. Slope percentage should be confirmed during the walk-through.
22. **Surface Expression:** Record the surface expression of the stratum. This information can be located in the silviculture prescription, or on the silviculture prescription cards. Surface expression should be confirmed during the walk-through. For more information on terrain, refer to Figure 2 on the FS 660 card.
23. **Site Index (SI) Method:** Record the method used to determine the site index for the stratum. The ISIS user guide contains the list of approved abbreviations.
24. **Site Index (SI) Species:** Record the species used to determine the site index for the stratum. These methods are described in the FS 660 card and site index training materials.
25. **LFH (cm):** Record the average depth (in centimetres) of the Litter-Fermented-Humus (LFH) layer of the forest floor. Measure from the top of the mineral soil to the top of the litter layer. This information can be located in the silviculture prescription, or on the silviculture prescription cards. LFH depth should be confirmed during the walk-through.
26. **Humus Form:** Record the humus form of the organic layer of the stratum. Three types of humus form are recognized: Mor, Moder, and Mull. The humus form classification can be located in the silviculture prescription, or on the silviculture prescription cards, but it can change following harvest. Humus form should be confirmed during the walk-through. For more information on humus form, consult the regional ecological classification field guide (a link to the Prince Rupert Forest Region is provided), or *Field Manual for Describing Terrestrial Ecosystems.*
27. **Soil Texture:** Record the soil texture of the stratum. This information can be located in the silviculture prescription. Soil texture should be confirmed during the walk-through. For more information on soils classification, consult the regional ecological classification field guide (a link to the Prince Rupert Forest Region is provided), or *Field Manual for Describing Terrestrial Ecosystems.*
28. **Effective Rooting Depth (cm):** Record the depth (in centimetres) of the soil that is available for root development. This should involve digging a soil pit, observing root mats of windthrown trees, or looking at road cuts. This information can be located in the silviculture prescription, or on the silviculture prescription cards. Effective rooting depth should be confirmed during the walk-through.
29. **Soil Depth (cm):** Record the depth (in centimetres) of the soil to bedrock. This should involve digging a soil pit, observing root mats of windthrown trees, or looking at road cuts. This information can be located in the silviculture prescription, or on the silviculture prescription cards. Soil depth should be confirmed during the walk-through.
30. **Drainage:** Check the appropriate box to indicate the drainage of water through the soil. Drainage is often related to the soil texture. This information can be located in the silviculture prescription, or on the silviculture prescription cards. Drainage should be confirmed during the walk-through.
31. **Coarse Fragments:** Check the appropriate box to indicate the estimated percentage of coarse fragment content. Coarse fragments are greater than 2 mm in diameter. This information can be located in the silviculture prescription, or on the silviculture prescription cards. Coarse fragment percentage should be confirmed during the walk-through.
32. **BGC Zone, Subzone, Variant, and Site Series:** Record the biogeoclimatic zone, subzone, variant, and site series of the stratum. This information can be located in the silviculture prescription, on the silviculture prescription cards in ISIS, and on biogeoclimatic subzone maps and handbooks. However, biogeoclimatic information should be confirmed during the walk-through.

    Current zone/subzone/phase/variant phase code combinations can be found at http://www.for.gov.bc.ca/research/becweb/bcinfo/index.HTM

Regional ecological classification zone and subzone maps and field guides should be used to confirm the biogeoclimatic zone, subzone, variant, and site series. Where the observed ecological classification for the opening differs from the silviculture prescription and is confirmed by the person responsible for the silviculture prescription, an amendment to the prescription is required.

The regional field guides for identification and interpretation of ecosystems are used to determine the site series of the stratum. Record the 1° (primary) site series that covers the majority of the stratum. Record the 2° (secondary) site series that is the next predominant site series that covers the stratum. Record the 3° (tertiary) site series, or third-most predominant site series that covers the stratum. If there is more than one site series present within the stratum, a percentage should be assigned to each of the different site series. The site series should be rounded to the nearest 10% and the combined site series percentages should equal 100%.

33. **Edatopic Grid:** The moisture and nutrient co-ordinates of the site can be determined by using the edatopic grid of the corresponding biogeoclimatic zone site series. This information can be located in the silviculture prescription, on the silviculture prescription cards, on biogeoclimatic maps, and in handbooks. However, the edatopic grid should be confirmed during the walk-through.

34. **p, a, u:** Check the appropriate box to indicate if the particular species is preferred (p), or acceptable (a), as a well-spaced or free growing tree for the stratum. This information is found in the silviculture prescription.

    The use of the unacceptable field (u) is intended to clearly identify tree species that are present on the stratum, but are neither preferred nor acceptable. List only those unacceptable tree species that appear to have potential as acceptable species but are not currently listed. Species that show signs of clearly being unacceptable as potential crop trees for this ecosystem need not be listed.

    If there is no silviculture prescription, the preferred and acceptable species are defined in the stocking standards provided by the district manager. This may be in the form of a district species selection guideline.

35. **Species:** Record the species that corresponds to the preferred, acceptable, and unacceptable fields of the FS 657 card. This information can be located in the silviculture prescription. If there is no silviculture prescription, the preferred and acceptable species are defined in the stocking standards provided by the district manager. Unacceptable species need only be included where unacceptable commercial tree species are present.

36. **Ht./Age:** Record the minimum height and minimum age of the corresponding well-spaced trees that will contribute to stocking at the regeneration date. This information is not located in the silviculture prescription, but may be provided by the district manager or licensee.

37. **FG Min. Ht:** Record the minimum height that a healthy, well-spaced tree must attain to be considered free growing. This information can be located in the silviculture prescription or provided by the district manager. If no free growing height is stipulated on the silviculture prescription, the free growing trees have no minimum free growing height requirement unless the licensee has selected to use the free growing guidelines described in Appendix 9 of the *Establishment to Free Growing Guidebook*.

38. **Quality (Condition, Free Growing Criteria):** Record the quality of the well-spaced/free growing trees that will be accepted during the survey. This information can be located in the silviculture prescription, district guidelines, and/or in the *Provincial Free Growing Damage Criteria*. All regions are identical. It is often useful to summarize the quality criteria with a phrase such as "As per the *Free Growing Damage Criteria 2001*" and include a copy of these criteria, along with any exceptions, in the final report to the district manager.

39. **Conifer/Brush Ratio (%):** Record the height of the crop tree relative to competing vegetation for free growing trees. This is usually recorded as a percentage. This information can be located in the silviculture prescription.

If no conifer/brush ratio stipulated on the silviculture prescription, there is no legal requirement for the free growing trees to meet a conifer/brush ratio. However, the crop trees must still be free growing, and the current method may be appropriate. Consult with the holder of the silviculture prescription on how to assess areas with no conifer/brush ratio specified in the silviculture prescription.

40. **Maximum Density (stems/ha):** Record the maximum allowable density of the total countable conifers. For more information on this subject refer to the Maximum Density Section.

41. **BAF:** Record the prism size used in completing the prism sweeps in a multi-storey survey. A discussion of this topic is found in Appendix 4. Used for multi-storey surveys in partially cut even-aged stands and intermediate cuts.

42. **Silviculture Prescription Free Growing Standards Used/Free Growing Guidelines Standards Used:** Check the appropriate box as to which standards are being used for the survey.

43. **Target Stocking Standard (trees/ha):** Record the target stocking standard (TSS) for the stratum being surveyed. The TSS is the target number of preferred and acceptable healthy, well-spaced or free growing trees per hectare. This information can be located in the silviculture prescription.

44. **Target Maximum/Plot:** Record the maximum number of well-spaced or free growing trees to be tallied in a plot for the stratum. Maximum per plot is also called the "M" value. This is calculated by dividing the target stocking standard per hectare by the plot multiplier (Field 58).

    The M value places a ceiling on the number of well-spaced trees and free growing trees in any one plot. This prevents overstocking in one plot compensating for understocking in other plots. This is a key concept in the survey system. Thus, a relatively uniform distribution of stems must be attained before the opening can achieve regeneration delay or free growing status.

    The "Target Idea Inter- tree Distance" field is no longer used.

45. **Minimum Inter-Tree Spacing:** Record the minimum inter-tree distance between well-spaced or free growing trees. Minimum inter-tree distance specifies the minimum allowable horizontal distance between preferred and/or acceptable trees that are well spaced or free growing. This information can be located in the silviculture prescription. For information regarding accepting trees at the distance allowed at the time of planting, refer to the Minimum horizontal distance section.

46. **Planting Stocking Standard (trees/ha):** Record the target number of planted trees per hectare desired in the stratum. This planting stocking standard is calculated using the formula in Field 53 of the FS 657 card, or set by district or licensee policy.

47. **Planting Maximum/Plot:** Record the maximum number of plantable spots to be recorded in a plot for the stratum. This is calculated by dividing the planting stocking standard per hectare by the plot multiplier, Field 58.

48. **Planting Ideal Inter-Tree Spacing:** This field is recorded in plantability surveys. This distance will be specified in the planting contract, Schedule B. It should be set in consideration of the instructions that will be given to the planting crews.

49. **Planting Minimum Inter-Tree Spacing:** Record the minimum inter-tree distance between planted and/or well-spaced trees. This distance will be specified in the planting contract, Schedule B. It should be set in consideration of the instructions that will be given to the planting crews.

50. **Minimum Stocking Standard Preferred and Acceptable (well-spaced stems/ha):** Record the minimum number of healthy, preferred and acceptable, well-spaced or free growing trees per hectare (MSSpa). This number of trees must be on an opening to consider the area satisfactorily restocked or free growing. This information can be located in the silviculture prescription. In older silviculture prescriptions, before the requirement to specify an MSSp (see next field), MSSpa is referred to as MSS.

51. **Minimum Stocking Standard Preferred (well-spaced stems/ha):** Record the minimum number of healthy, preferred well-spaced or free growing trees per hectare (MSSp). This number of trees must be on the opening to consider the area satisfactorily restocked or free growing. This information can be located in the silviculture prescription.

    If the silviculture prescription was approved before April 1, 1994, there will be no minimum stocking standard for preferred species. This field will then be recorded as "–" or N/A. The exception would be if the silviculture prescription states that a particular species is limited to a specified percentage or regional directives exist that set these limits (see section on MSS vs. MSSp vs. MSSpa).

52. **Expected Survival %:** Record the estimated expected survival of the species that will be planted on the site. This information comes from the contract or the district manager, or can be based on local knowledge or on practical experience. If more than one species is recommended for planting on the site, the expected survival rate is a combined or pro-rated estimate of each species.

53. **Planting Stocking Standard Calculation:** The planting stocking standard is calculated by the following formula:

Target stocking standard (trees/ha)	÷	Expected survival % (expressed as a decimal)	-	Natural fill-in rate (trees/ha)	=	Rough estimate of planting density (trees/ha)

    The contract should provide the number for the expected natural fill-in rate. The planting stocking standard is always rounded *up* to the nearest 200. For example, if the planting stocking standard calculation resulted in 1233, this number would be rounded to 1400.

    The planting stocking standards calculation can be overridden by the planting contract.

54. **Distance between Plots (m):** Record the average distance (in metres) between plots that was used during the survey. If a random sampling design was used, note "random" in this field, or leave it blank.

55. **Distance between Lines (m):** Record the average distance (in metres) between strip lines that was used during the survey. If a random sampling design was used, note "random" in this field, or leave it blank.

56. **Plot Radius (m):** Record the plot radius (in metres) used for the survey. This is commonly 3.99 m.

57. **Plot Area (m^2):** Record the plot area (in m^2) associated with the plot radius used for the survey. This number can be found on Table 6 of the FS 660 card. This is commonly 50 m^2, for 3.99 m radius plot.

58. **Plot Multiplier (pm):** Record the number used to multiply the tree counts in the survey plot to yield equivalent trees per hectare. Refer to the Plot Radius and Plot Multiplier section for more information. This number can also be found in the FS 660 card.

5.2.2 Basic Site Information (back of FS 657 Card)

Information to complete the back of the FS 657 (Figure 17) is gathered during the walk-through of the stratum. It is important that the information collected in this section be accurate so that it can be incorporated into the development of treatment recommendations and contract requirements.

Figure 17. FS 657 Silviculture Survey card (back).

Fields 60–65 need only be completed if a plantability survey is an objective of the survey.

59. **Stratum/Opening/Licence/CP/Block:** Repeat from the front side of the card.
60. **Screefing Depth:** Record the maximum depth (in centimetres) that is required by the planter to remove the organic matter from a spot to prepare it for planting. This information is district specific, and more often site specific.
61. **Scalp Size:** Record the maximum scalp size (in centimetres) that is required by the planter to remove the organic matter from a spot to prepare it for planting. When recommending the maximum scalp size, consider vegetative competition and soil nutrient status. This information is district specific and more often site specific.
62. **Acceptable Planting Medium:** Record the acceptable planting medium for the site. For example, "mineral soil" or "organic/mineral mix" may be recorded here.
63. **Tree Species Planters Must Recognize:** Record the tree species that a planter must recognize during planting either to respect or to ignore. This information will be site-specific depending on the biogeoclimatic zone site series.

64. **Minimum Height for Trees to Be Visible:** Record the minimum height of a tree (in centimetres) that a planter is expected to see during planting and that will influence the number of plantable spots. This value may be different than that shown in the acceptable tree characteristics under height/age on the front of the FS 657 card. This information will be site specific. When establishing this value, consider the height of surrounding vegetation.
65. **Planting Difficulty:** Check the box that represents the average planting difficulty for the stratum. This information is site specific and can be determined by using Table 3 on the FS 660 card.
66. **Estimated Slash Cover:** Record the estimated percentage of the ground that is covered by slash and debris. This visual observation should be averaged throughout the entire stratum. Slash cover percentage should be estimated during the walk-through.
67. **Average Slash Height (cm):** Record the estimated height (in centimetres) of the slash and debris on the ground. This visual observation should be averaged throughout the entire stratum. Average slash height should be estimated during the walk-through.
68. **Slash Class:** Check the box next to the appropriate estimated slash class. This visual observation should be averaged throughout the entire stratum. Slash class should be estimated during the walk-through.
69. **Slash Distribution:** Record the estimate of slash continuity. This visual observation should be averaged throughout the entire stratum. Slash distribution should be estimated during the walk-through.

    Continuous — slash is spread evenly over the stratum.

    Patchy — slash-free areas cover approximately the same percentage of ground as slash-covered areas.

    Scattered — slash-free areas are larger than slash-covered areas.
70. **Estimated Brush Cover:** Record the estimated percentage of competing vegetation within the stratum. This visual observation should be averaged throughout the entire stratum. Brush cover should be estimated during the walk-through.
71. **Average Brush Height (cm):** Record the estimated height (in centimetres) of the competing vegetation within the stratum. This visual observation should be averaged throughout the entire stratum. Average brush height should be estimated during the walk-through.
72. **Brush Severity:** Check the box next to the appropriate estimate of brush severity. This visual observation should be averaged throughout the entire stratum. Brush severity should be estimated during the walk-through.
73. **Brush Distribution:** Record the spatial arrangement or distribution estimate of brush continuity. This visual observation should be averaged throughout the entire stratum. Brush distribution should be estimated during the walk-through.

    Continuous — brush is spread evenly over the stratum.

    Patchy — brush-free areas cover approximately the same percentage of ground as brush-covered areas.

    Scattered — brush-free areas are larger than brush-covered areas.
74. **Snags:** Record the estimated number of snags per hectare that are greater than 5 m in height. This visual observation should be averaged throughout the entire stratum. The number of snags should be estimated during the walk-through.
75. **Work Hazard:** Record the estimated potential work hazard that the snags may pose to workers on the site. Check the appropriate box. This visual observation should be averaged throughout the entire stratum. Work hazard should be estimated during the walk-through. It is often valuable to describe the snag distribution. For example, "found in south corner only" or "none in block, or many on perimeter." Visit the Ministry of Forests' Web site for information about wildlife danger tree assessment.

76. **Machine Trafficability:** Record the ability of a machine to travel through the stratum. Check the appropriate box next to machine trafficability. This visual observation should be averaged throughout the entire stratum. Machine trafficability should be estimated during the walk-through and will be impacted by slope, slash, soil moisture, residuals, and drainage patterns (i.e., creeks).
77. **Soil Compaction Hazard:** Record the soil compaction hazard rating of a machine traveling through the stratum. Soil compaction hazard can be estimated during the walk-through as an average throughout the stratum. This information can be determined by using Table 15 on the FS 660 card.
78. **Resource Values:** Record the presence or absence of the specified resource values in the area by checking the appropriate boxes, using visual observations. Resource values can be estimated during the walk-through. They can also be found in the silviculture prescription.
79. **Access:** Record the distance (in kilometres) to the opening from a known location. The kilometres should be listed by each of the individual modes of transportation.
80. **Travel Time:** Record the estimated time required to travel to the opening from a known location. The time is to be recorded in hours and should be rounded off to the nearest quarter hour.
81. **From:** Record the nearest known location. This can be a city, town, village, settlement, or camp.
82. **Potential Road Construction and Maintenance Problems:** Record on the card and note on the survey map any road construction and maintenance problems that could be encountered during any upgrading, construction, or reconstruction of the access to the opening. This is also a good location to record any road deactivation.
83. **Accommodation:** Record the most convenient accommodation available when surveying the opening. This may be useful for crews returning to conduct a future treatment.
84. **Other:** This field is left open for general comments about the stratum. The following are examples of what could be recorded:
    - success of treatments to date
    - defining characteristics of the stratum
    - the major limiting factors to achieving free growing
    - the average snow depth during the time of survey
    - ribbon colour used
    - the preliminary treatment recommendation(s) for the stratum

5.3 Silviculture Survey Plot Card (FS 658)

The Silviculture Survey Plot Card FS 658 is commonly used to collect data from individual plots during a silviculture survey. Data from the FS 658 card(s) are then summarized on the Silviculture Survey FS 659 Summary cards. The following pages detail the information to be recorded on the FS 658. The sample FS 658 (Figure 18) has a number in each of the fields that corresponds with the following headings.

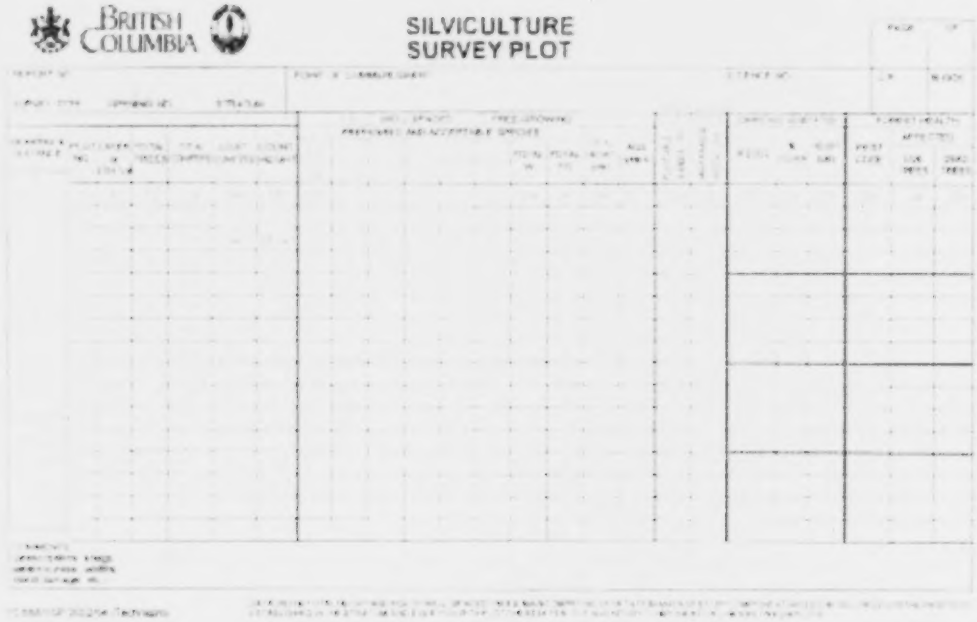


Figure 18. FS 658 Silviculture Survey Plot card.

1. **Report No./Survey Type:** The appropriate abbreviations are RG – stocking survey; FG – free growing survey; PL – plantability survey; SU – survival survey; BR – brushing.
2. **Opening No.:** Copy the opening number from the FS 657 Field 4.
3. **Stratum:** Copy the opening number from the FS 657 Field 11.
4. **Point of Commencement:** Record a written description of the location of the point of commencement in the field. This location should be identifiable on an air photo and a map to ensure the strip lines and plots can be accurately positioned on a map at the completion of the survey. This also applies to random plots.
5. **Page:** Record the page number. Include all silviculture survey cards in a logical numbering sequence. The goal is to provide a logically organized package of survey cards to include in the finished report.
6. **Licence No.:** Copy the licence number from the FS 657 Field 6.
7. **CP No.:** Copy the cutting permit number from the FS 657 Field 8.
8. **Block:** Copy the block number from the FS 657 Field 9.

9. **Bearing and Distance:** Record the bearing and distance from the point of commencement to the first plot. Surveyors do not universally fill this field out the same way. Some surveyors may write 90° at 100 m, or 100 m E, or 100 m @ 90°. The bearing and distance data are recorded from the plot above to the plot below. If the bearing and distance are from a plot that does not directly precede the present plot, then a reference should be made to the preceding plot. For example, 100 m E of plot 12.
10. **Plot No.:** Record the plot number assigned to the plot.
11. **Layer:** This field is applicable to multi-storied surveys, or even-aged systems with retention. This field is left blank on most other even-aged surveys. In multi-storied stands, four layers (1 - mature, 2 - pole, 3 - sapling, 4 - seedling) are tallied separately in each plot.
12. **Total Trees:** Record the total number of live coniferous and broadleaf trees within the plot. This includes both acceptable and unacceptable quality trees. Non-commercial tree species (as defined by the Resource Inventory Branch) are not tallied under total trees. *All trees, regardless of their height, are to be tallied, including germinants.* Table 6 provides guidance on the level of accuracy required.
13. **Total Conifers:** Record the total number of live coniferous trees, including both acceptable and unacceptable quality trees, in the plot. *All conifers, regardless of their height, are to be tallied, including germinants.* Refer to BC Tree Code List version 4.1 for a list of the tree species, the codes, and the common names of those species that are found in British Columbia.
14. **Count. Conifers:** Record the total number of live coniferous trees in the plot, regardless of species and quality, that are greater than or equal to the minimum countable height (see Field 15). These data do not need to be collected during stocking surveys. It may not be required for strata that are obviously less than maximum density. Discuss this with the local district representative.

    The term "countable trees" is used in reference to maximum density determination.

When a free growing survey is carried out, only conifers meeting or exceeding the minimum countable height are used in the maximum density calculation. In the strictest interpretation of the Silviculture Practices Regulation Section 25 (b) (vi), countable conifers must be reported.

On areas where the number of countable conifers is well below the maximum density, it would be irrelevant to collect countable conifer data. Because these data can be time consuming to collect, you may wish to discuss not collecting these data in these circumstances with the district manager.

For even-aged stands, countable height is 20% of the median height of the preferred and acceptable well-spaced trees selected in the plot. Where the number of well-spaced trees exceeds the M value, use the median height of the tallest trees equal to the M value.

To determine the median height for an even-aged opening, identify the tallest well-spaced trees in the plot up to the M value. If there is an odd number of well-spaced trees in the plot, determine the height of the middle well-spaced tree and multiply that height by 20%. This equates to the countable height for that particular plot. Refer to Figure 19.

If there is an even number of well-spaced trees in the plot, select the two middle height, well-spaced trees and measure the total height of each of the two trees. Average these two heights to determine the median height. Multiply the median height by 20%. This equates to the countable height for that particular plot. Refer to Figure 20.

For stands managed on single tree selection, all conifers in layer 3 (> 1.3 m tall but < 7.5 cm dbh) contribute toward the maximum density calculations.

In Figure 19, the countable height is equal to the measured height of tree no. 4 times 20%.

Figure 19. An example of median height determination with an odd number of well-spaced trees on an even-aged stand.

In Figure 20, the countable height is determined by the average of the measured heights of trees no. 2 and no. 4, times 20%.

Figure 20. An example of median height determination with an even number of well-spaced trees on an even-aged stand.

15. **Count. Height:** Record the countable height. For even-aged stands, this number is calculated as 20% of the median height of the well-spaced trees selected in the plot. See median height determination for more information.

    For openings managed on an uneven-aged basis, the calculation of countable height is not applicable, as all conifers in layer 3 contribute towards the maximum density calculations.

16. **Well-Spaced or Free Growing:** Check the appropriate box that corresponds to the primary objective of the survey indicated in Field 17 of the FS 657. Selecting one of these boxes will signify that the data collected in the columns of Field 23 represent either well spaced or free growing.

    Figure 21 outlines the two methods of tallying trees in a single plot. All of the conifers in the diagram are preferred or acceptable species and meet the well-spaced criteria.

Figure 21. An example of tallying well-spaced trees.

When conducting a stocking survey, the surveyor is expected to maximize the number of well-spaced trees in each plot, even if this means a reduction in the number that are preferred species, within the limits of the M value.

By selecting only preferred species (marked "P" in Figure 21), only 5 trees would be identified as well spaced. By selecting a mix of both preferred and acceptable species, more will be identified. If the M value were 6, it would be simple to select 4 preferred plus 2 acceptable, thereby maximizing well spaced to the M value.

17. **Blank (no title):** Use this field to enter "p" indicating that the species directly below in Field 18 is a preferred species. Enter an "a" to indicate that the species in Field 18 directly below the "a" is an acceptable species. The preferred and acceptable species are listed on the FS 657 Field 34.
18. **Blank (no title):** Enter the species that correspond to the species in Field 17 directly above. The preferred and acceptable species are listed on the FS 657 Field 34.
19. **Plantable:** Check (✓ or ×) in this box if a plantability survey is a survey objective. It is recommended that plantability data be collected on all surveys where significant quantities of plantable spots are present. If a multi-storey survey is being completed, plantability is recorded in the row of data corresponding to layer 4, or the lowest layer recorded.
20. **Number "In":** Check (✓ or ×) in this box, if a multi-storey survey is being completed. The data entered here correspond with the data collected for layer 1, and represent the number of layer 1 trees found within the prism sweep. These data are also used to calculate the basal area.
21. **Preparable:** Check (✓ or ×) in this box only if a plantability survey is a survey objective. If a multi-storey survey is being completed, record preparable data in the row of data corresponding to layer 4, or the lowest layer recorded.
22. **Modal Diam.:** Check (✓ or ×) in this box only if a multi-storey survey is being completed. The data entered here correspond with the data collected for layer 1 and represent the most frequently observed diameter of the layer 1 trees found within the prism sweep.

23. **Titles Based on Fields 17 & 18 of the FS 658:** Record the number of well-spaced or free growing trees in the appropriate species column including those that exceed the M value.

    The data collected during a silviculture survey will now be used to answer two different questions:

    1. Has the minimum stocking requirement been met, and therefore is the area satisfactorily stocked or free growing?
    2. What is the total number of well-spaced or free growing trees per hectare?

    The stocking status of a stratum is still determined based on the survey results that apply the M value. The reporting of well-spaced or free growing trees per hectare in silviculture labels is also still based on survey results that apply the M value.

    Unacceptable species can also be recorded here if they are performing well on the opening. Refer to the recording unacceptable species as well-spaced or free growing section for more information about recording unacceptable species.

24. **Total W:** If conducting a stocking survey (Field 16 "well-spaced" is checked), record the sum of the preferred and acceptable well-spaced trees in the plot, up to the maximum per plot indicated on the FS 657 (M value). If the maximum value is reached, or exceeded, record the letter "M" rather than the numeric value. The "M's" will be used in calculations on the FS 659 card.

    When conducting a free growing survey (Field 16 "free growing" is checked), record the sum of the all free growing and any additional well-spaced, but not free growing trees including those that exceed the M value. Do not record an M when the maximum number of trees per plot is reached. Record the actual total.

25. **Total FG:** If conducting a stocking survey (Field 16 "well-spaced" is checked) record the sum of the preferred and acceptable well-spaced trees in the plot that are also free growing trees, in the plot up to a maximum of the M value. If the maximum value is reached, or exceeded, record the letter "M" rather than the numeric value.

    When conducting a free growing survey, the surveyor must maximize the number of preferred and acceptable trees that meet the criteria for an acceptable free growing tree. Record the sum of preferred and acceptable free growing trees in the plot, up to the maximum per plot indicated on the FS 657 (M value). If the maximum is reached, or exceeded, record the letter "M" rather than the numeric value.

26. **Total Height (cm):** Record the total height (in centimetres) of the well-spaced sample tree. Sample height data are collected at the first plot and at every fourth plot after that, by stratum. Where few plots are established in a stratum, it is necessary to record a sample height more often than every fourth plot. It is recommended that a minimum of three height samples be collected per stratum, although the more samples collected, the more accurate the data.

    Measure and record the total height from the point of germination to the top of the bud of the primary leader of the tree. The sample tree should represent the *average height* of well-spaced trees in the plot for stocking surveys and of free growing trees for free growing surveys.

    Where surveys are being conducted during the growing season, record the height to the last completed year's growth. A survey conducted in June or July will not include the current year's leader growth. The surveyor should make a comment to indicate how height was measured.

27. **Age (years):** Record the age of the sample tree (well-spaced trees in the plot for stocking surveys, and free growing trees for free growing surveys). The sample age must be derived from the same tree as in Field 26. Collect sample tree age data at the first plot and at every fourth plot thereafter, for each stratum. It is recommended to collect a minimum of three age samples per stratum, although the more samples collected, the more accurate the data.

In older or multi-storied stands, tree ages are based on ring counts derived from bored core samples. Samples must include the correction factor for the bore height based on the site index. Appendix 7 contains a table to adjust the age at boring height to the actual age.

The age of many young stands can be reliably estimated by counting the number of whorls in species that exhibit determinate growth. Cutting a disc from the base of a sample tree and counting the number of rings will also estimate the age of younger trees, and those species of undetermined growth. Age is most accurately determined by destructive sampling.

Adjustments for the age of planting stock or other similar factors are not necessary.

Where surveys are being conducted during the growing season, record the number of completed years' growth. The reported age may be more accurately described as the number of completed growing periods. In this case, the reference year in the silviculture label should correspond to the number of growing periods (actual year minus one).

28. **Plantable and Number "In":** Record the number of plantable spots found in the plot. A plantable spot is defined as a suitable microsite on which a seedling could be planted (see the FS 657 Fields 57–61). The suitability of the microsites depends on site conditions and limiting factors such as soil moisture, soil temperature, soil nutrients, climatic conditions, tree species, and the stock type to be planted. The intent of recording the number of plantable spots is to determine if planting can be completed without site preparation. It will also estimate the number of seedlings that will be required to complete a planting project on the survey area. As a result, it is important to record the number of plantable spots based on the same criteria that will be used by the planters. Because the planters will be instructed to plant trees on microsites as directed by the licensee's silviculture staff, it will be important to discuss planting spot selection with them prior to conducting the survey.

    For multi-storey surveys, the plantable data are recorded in the row for layer 4 (or the lowest layer), and the number of layer 1 trees "In" the prism sweep is recorded in the row for layer 1.

29. **Preparable:** Record the number of preparable spots found in the plot. A preparable spot is defined as microsites that is presently unsuitable for planting but, with site preparation, could become an acceptable planting microsite. Preparable spots are tallied independent from plantable spots.

30. **Competing Vegetation – Species:** Record the first four letters of the genus, followed by the first three letters of the competing herbaceous, shrub, or brush species (see FS 660). Consult with the district for a comprehensive list of competing vegetation.

31. **Competing Vegetation – % Cover:** Record the average percentage of the ground that is covered by the competing vegetation species. This is an ocular estimate of the competing vegetation percentage cover in and around the plot, not just within the plot.

32. **Competing Vegetation – Height (cm):** Record the average height (in centimetres) of each of the competing vegetation species. This is an ocular estimate based on the average height of the competing vegetation in and around the plot, not just within the plot.

33. **Forest Health – Pest Code:** Record the applicable pest code of the forest health factors on each affected tree within the plot. Only those trees that are found to be unacceptable based on the free growing damage criteria are recorded. Forest health data are collected at every plot. If there is more than one forest health factor on the same tree, only one need be recorded. The forest health factor that will have the longer and or more damaging impact on the stand should be recorded.

    Refer to the *Damage Agent and Condition Codes FS 747* for a comprehensive list of forest health factors and their corresponding pest code.

    If a forest health factor is unknown or uncertain, describe and record the type of damage, obtain a sample, and consult either the Field Guide to Forest Damage in British Columbia, or the district or regional forest health specialist.

34. **Forest Health – Live Trees:** Record the number of live trees affected by the forest health factors described in Field 33.
35. **Forest Health – Dead Trees:** Record the number of dead trees affected by the forest health factors described in Field 33.
36. **Inventory Label:** Inventory labels are determined through visual observations from within the stratum, not directly through plot data. Collect at least three sets of observations (or roughly 1 per 4 plots established) per stratum. These will be averaged later and combined with data from other sources to generate an inventory label for the stratum.

    The components are:

    - species – determine the species composition to the nearest 10%
    - age – average age of the dominant and co-dominant leading species and second species trees
    - height – average height of the dominant and co-dominant leading species and second species trees
    - crown closure – estimated to the neared 10%, see FS 660, 9D.

    As a recommendation, inventory label data should be collected in at least three plots per stratum, although the more data collected, the more accurate the inventory label.

    Sample inventory label data are as follows:

    $$Fdi_6Lw_3At_1\text{-}9/8\text{-}1.9/1.6\text{-}8$$

    This label represents a species composition of 60% Douglas-fir, 30% western larch, and 10% aspen. The dominant and co-dominant Douglas-fir are 9 years old and the western larch are 8 years old; the average height of the dominant and co-dominant trees are Douglas-fir, 1.9 m tall, and western larch, 1.6 m tall; and the crown closure is 8%.

    Because no field is specified to record these data, they can be recorded on a row below the last collected plot.

    When plot data are recorded for multiple strata on the came FS 658 card, it is important to note the stratum that the data represents.

37. **Comments (prescriptions, snags, watercourses, wildlife, stand damage, etc.):** Record site-specific details that are relevant to the survey and potential treatment recommendations.

5.4 Allowable Errors in Measurement

The Ministry of Forests silviculture surveys contract specifies the allowable errors for a number of important data collection components. These limits are also appropriate for all silviculture surveys used to assess fulfillment of silviculture prescriptions (Table 6).

Table 6. Allowable errors in measurement

Item	Allowable error
P.O.C. and P.O.T.	± 10 m
All bearings	± 2°
All plot centres and tie points	± 2% of horizontal distance
Plot radius	± 1% of horizontal distance
Closed traverse	± 1% error of closure
Estimated tree heights:	
• < 2 m	± 10 cm
• 2–10 m	± 10%
• > 10 m	± 20%
Measured tree heights	± 5%
Estimated tree diameters	± 20% (rounded to the nearest whole cm)
Estimated stand age	± 20%
Site index	± 3 m (for Growth Intercept Method)
Stratum area in hectares	+ 10%

5.5 Forest Health

In a survey, any cause of tree damage is called a forest health factor. A forest health factor is only considered to be a pest on a particular opening when it presents a risk to the successful achievement of management objectives. As a result, only "pests" are recorded in our plot data.

Surveyors are expected to record each incidence of all forest health factors that are found to be unacceptable on all trees in all plots, based on the free growing damage criteria. If two forest health factors are observed on the same tree, only the one with the more detrimental effect is recorded. For example, a pest that causes mortality should be recorded over one that causes a growth rate reduction.

When it appears that a particular forest health factor is a serious problem in an opening, the survey should be scheduled for a time when the factor is most apparent and easily seen.

Forest health is a key component of stratification. Areas with treatable incidence levels of forest health factors should be stratified as a separate stratum, as should areas that are NSR or not free growing because of a high incidence of forest health factors.

Useful forest health references include the following Forest Practices Code guidebooks:

- *Forest Health Surveys*
- *Bark Beetle Management*
- *Defoliator Management*
- *Dwarf Mistletoe Management*

- *Terminal Weevils*
- *Pine Stem Rust Management*
- *Root Disease Management*
- *Tree Wounding and Decay*

A valuable companion reference to these guidebooks is the course materials for the *Forest Health for Silviculture Surveyors* (2000), as well as the *Forest Health Network's Common Tree Diseases of British Columbia* at http://www.pfc.cfs.nrcan.gc.ca/diseases/ctd/index_e.html.

A useful field guide is the Field Guide to Forest Damage in British Columbia.

Optimal survey timing with respect to forest health factors is discussed in the *Silviculture Survey Guidebook*.

5.6 Unique Stand Structures and Survey Procedures

5.6.1 Group Selection Stand Structures

Under development

The following excerpt from the report *To Guide Silviculture Prescription Development and Future Management Activities in the Britannia Beach Operating Area* by Ken Zielke RPF provides guidance and can be used as an interim set of procedures for surveying in group selection areas.

5.6.2 Even-aged Stand Structures with Uniform Short- or Long-term Retention

Under development

5.6.3 Even-aged Clustered Stand Structures

Cluster treatments result in groups of trees that do not have a relatively even spatial distribution. Cluster treatments can increase biodiversity, while reducing planting and vegetation management costs. Cluster treatments may also be used on openings that have a reduced number of microsites suitable for tree survival and growth. Examples of these treatments are cluster planting and cluster juvenile spacing. The silviculture prescription sets a minimum inter-tree distance that is commonly lower than the minimum inter-tree distance used on non-cluster treated openings.

The stand-level objectives of the cluster treatment must be clearly defined before beginning the survey. Objectives may include:

- total trees per hectare
- number of trees per cluster
- minimum inter-tree spacing
- maximum inter-tree spacing
- total clusters per hectare
- inter-tree spacing
- cluster "design"

The survey data collected may change depending on the objective of the survey, but the data and recording techniques will be consistent with other survey types. For example, when determining planting

quality, the conventional planting criteria will be assessed (e.g., plantable spots, number of trees planted, excess trees, satisfactorily planted trees) with the addition of cluster spacing and/or clusters per hectare.

Establishment of plots will follow the same procedures as other silviculture surveys, except that a larger plot radius is recommended. A 5.64 m radius plot is recommended to be used where there are more than 100 clusters per hectare. Openings having fewer than 100 clusters per hectare may require an even larger plot.

At each plot, the surveyor should record the number of cluster centres that fall within the plot radius and the number of trees that fall within the plot radius. Regardless whether the cluster centre falls within the plot radius or not, the trees that fall within the plot should be tallied.

5.6.4 Mixedwood Stand Structures

Mixedwood stand structures result from a variety of management strategies. Survey procedures for mixedwood aspen-white spruce stands created by strip shelterwood harvesting are described in the *District Operating Procedures for Spruce Understorey Retention on Pulpwood Agreement 14*.

5.7 Reserves

Reserves are forested patches or individual trees retained during harvesting or other forestry operations to provide habitat, scenic values, biodiversity, or other values. They are long-term retention areas generally left one rotation or longer. Trees retained for a short term, such as seed or shelterwood trees, are not reserve trees, and are described in conjunction with the description of the silvicultural system on the silviculture prescription.

Reserve patches do not normally have harvest entries. However, entries may occasionally be required to address safety concerns or a management objective such as forest health. Where a harvest entry occurs, a Standards Unit must be delineated for that reserve and the licensee may have reforestation responsibilities. Where removals are very light, there may not be any regeneration objectives. If the licensee has reforestation responsibilities, surveys must be conducted on these areas.

No silviculture responsibilities are associated with reserve patches that have no harvest entries.

5.7.1 Reserve Data to Collect during the Silviculture Survey

Ground surveys are performed only in those reserves in which harvesting occurred. For reserves in which harvesting has not occurred, the reserve can be described on the forest cover form based on pre-harvest stand information (e.g., from older forest cover maps or from timber cruise information), plus the addition of a reference year.

The subject is discussed in the FS 708 user guide

There is no standard location for these data to be recorded on the current plot cards because they are required irregularly. The comment area on the FS 658 is acceptable. These data are usually transferred to project maps and or recorded on the FS 708C, FS 922, or FS 810A.

5.8 Special Surveys

5.8.1 Use of Planting Quality Inspection Plots (FS 704) to Meet the Regeneration Date

Under the *Forest Practices Code of British Columbia Act*, stocking establishment can be achieved through planting. Certain conditions must be met for the stocking requirements to be fulfilled at time of planting:

1. Less than 10% of the total trees after planting are natural regeneration or previously planted trees (i.e., silviculture label = inventory label).
2. The minimum planting inter-tree distance must equal or exceed the minimum inter-tree distance specified in the silviculture prescription.
3. FS 704 plots are properly stratified (by Standards Unit) and evenly distributed over the opening.
4. All the species planted are listed as preferred for the applicable stratum in the silviculture prescription. (On the rare occasion where both preferred and acceptable species are planted, the FS 704 plots are not sufficient.)
5. The well-spaced trees in the FS 704 plots are tallied to a maximum of the "M" value for the target stocking standards (not the planting target stocking standard) to show that the minimum stocking has been met or exceeded. The total number of well-spaced trees (trees planted > minimum inter-tree distance) should also be recorded and reported.

   If all of the previous conditions exist, the data from the FS 704 plots are adequate evidence that regeneration obligations have been met. The data should be compiled in the same format as a stocking survey report outlined in "Content of a Stocking Survey Report" in the *Silviculture Surveys Guidebook*

If more than 10% of the total trees after planting are naturally regenerated or previously planted trees, or any of the other conditions previously mentioned do not exist, then a stocking survey must be carried out. The stocking survey can be completed with the planting quality inspection or separately.

5.8.2 Use of Juvenile Spacing Quality Inspection Plots (FS 749) to Meet Free Growing Declaration

Stands that exceed maximum density are overstocked, and achieving minimum stocking levels is not a concern. Therefore, juvenile spacing quality inspection plots can be used to declare an opening free growing if all of the requirements of a free growing survey report are met, and submitted to the district manager.

> Additional data that are not normally collected as part of the juvenile spacing quality inspection plots will be required. The most thorough method to meet the reporting requirements is to complete a minimum number of 5 free growing plots while collecting the desired number of FS 749 plots.
>
> Visual assessments are often suitable to collect the needed free growing data following spacing treatments.

5.8.3 Visual Assessments

A visual assessment is a relatively subjective assessment of an opening when compared with the more formal methods of silviculture surveys described in this manual. This survey method may also be referred to as a "reconnaissance survey." It should not be confused with the walk-through done before silviculture surveys.

A visual assessment should be conducted adhering to conventional survey objectives and guiding principles. However, the data gathering procedure becomes less formal. The visual assessment may be a general reconnaissance of the opening, done by walking through, driving through, or flying over the opening. The information collected will generally involve ocular estimates with few, if any, plots established and a limited amount of quantitative data.

When conducted by a skilled surveyor, the survey results can be sufficiently reliable to meet the required objectives and precision level of the survey.

Visual assessments are a valid survey method. Visual assessments can be efficiently and effectively employed where current conditions are visually evident, or where a limited amount of data is required to confirm what is visually apparent, or for safety reasons (e.g., helio-logging or hand-logging areas).

The results of the visual assessment are expected to be significantly similar to those that would result from a formal survey.

This survey is best employed when:

- the outcome of the survey is obvious and only few data are required to substantiate a recommendation (i.e., where the outcome is intuitively known);
- skilled surveyors are used to make determinations and estimates based on their experience and professional judgment;
- an update or confirmation of conditions or characteristics following a treatment is needed; and
- an opening is nearing the early free growing date, and the manager wishes to determine if the opening is on track to meet the free growing assessment period, or that an intervention is required.

For example, an experienced surveyor flies via helicopter over a 13-year-old cutblock at low altitude. There are no signs of dead or dying trees, the species composition is clearly a single species, the previously planted trees are now 4 m tall. Few if any quantitative data are required to confirm the obvious free growing nature of this block. A visual estimation of the silviculture and inventory label is acceptable.

In a second example, a free growing survey in year 9 recommends a brushing treatment, which is done at year 10, and the early free growing date is at year 12. The opening is revisited in year 12 to confirm continuing free growing status and update the inventory and silviculture label data.

The surveyor should be experienced in estimating stocking or free growing information. Sufficient data should be gathered to recommend the next treatment.

This survey method lends itself to incorporate "high tech" equipment, such as aerial assessments, video, infra-red assessments, and digital cameras.

In all cases, the data collected must satisfy the reporting requirements specified in the Silviculture Practices Regulation.

5.8.4 Data Compilation (FS 659)

For each stratum identified and confirmed in the field during the walk-through, a separate compilation must be completed. If compiling well-spaced and free growing data for the same stratum, the data must be compiled separately on two different FS 659 cards. Various field cards (e.g., Silviculture Survey Summary FS 659, Calculation Card for Silviculture Survey Confidence Limits FS 1138A, Steps to Calculate Confidence Limits for Silviculture Surveys FS 1138B, and Silviculture Survey Reference FS 660) are available to assist in data compilation.

The FS 659 is used to summarize data collected on the FS 657 and FS 658. Before leaving the opening, statistical calculations must be completed to ensure statistical precision has been met. Additional plots may need to be established to meet statistical precision. Comments that will be used to create treatment recommendations should also be recorded before leaving the opening.

The process of completing the FS 659 is described in the following section. Refer to the FS 657 and FS 658 cards to assist in completing this card.

5.8.5 Data Field Descriptions for FS 659

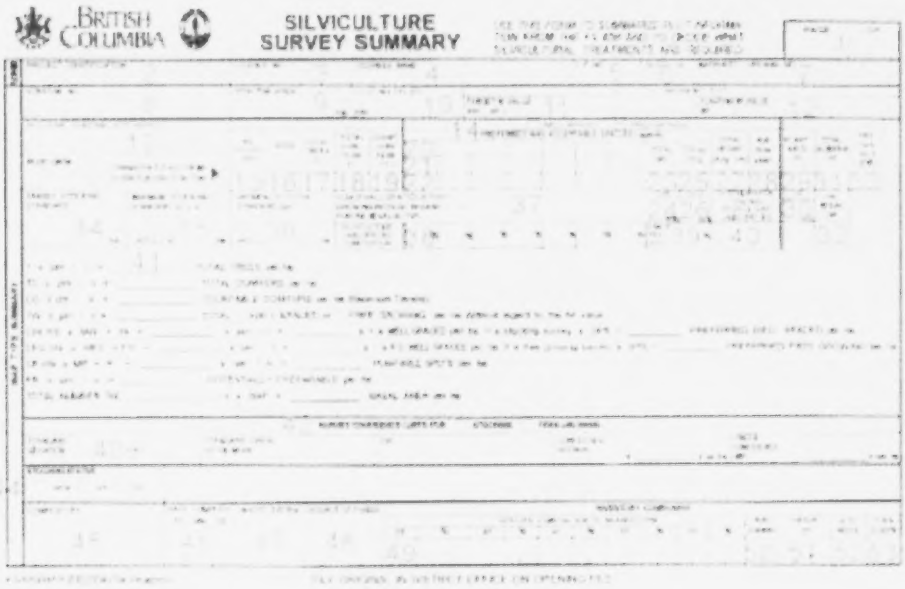


Figure 22. FS 659 Silviculture Survey Summary card.

1. **Page:** Record the page number. Include all silviculture survey cards in a logical numbering sequence. The goal is to provide a logically organized package of survey cards to include in the finished report.
2. **Project Identification:** Copy the Project Identification (Field 5) from the FS 657 card.
3. **Licence No.:** Copy the Licence No. (Field 6) from the FS 657 card.
4. **Licensee Name:** Copy the Licensee (Field 7) from the FS 657 card.
5. **C.P. No.:** Copy the C.P. No. (Field 8) from the FS 657 card.

6. **Block No:** Copy the Block No. (Field 9) from the FS 657 card.
7. **Mapsheet/Opening No.:** Copy the Mapsheet/Opening No. (Field 4) from the FS 657 card.
8. **Stratum No.:** Copy the Stratum No. (Field 11) from the FS 657 card.
9. **Stratum Area:** Copy the Stratum Area (ha) (Field 12) from the FS 657 card.
10. **Plot Multiplier (pm):** Copy the plot multiplier (pm) (Field 58) from the FS 657 card.
11. **Maximum/Plot - Target (MW) or (MFG):** Copy the Target Maximum/Plot (Field 43) from the FS 657 card.
12. **Maximum/Plot – Planting (MP):** Copy the Planting Maximum/Plot (Field 46) from the FS 657 card.
13. **BGC Zone, Subzone, Site Series:** Copy the BGC zone, subzone, site series (Field 32) from the FS 657 card.
14. **Well-Spaced or Free Growing:** Check *only one* box indicating which type of survey data is used for the data compilation (well-spaced or free growing). If a stocking survey was completed at the same time as a free growing survey, they must be compiled separately and two FS 659 cards must be completed.
15. **No. Plots (n):** Record the number of plots established in the stratum.
16. **Layer:** This field is not usually used for even-aged surveys. Record the layer number (1, 2, 3, or 4), which is being summarized for a multi-storey survey.
17. **Total Trees (T):** Record the sum of the total trees from the Total Trees (Field 12) of the FS 658 card.
18. **Total Conifers (TC):** Record the sum of the total conifers from the Total Conifers (Field 13) of the FS 658 card.
19. **Countable Conifers (CC):** Record the sum of the countable conifers from the Countable Conifers (Field 14) of the FS 658 card. If compiling data for a stocking survey, data will not be recorded in this field.
20. **Blank field on the card (no title):** Copy the species or the "p," "a," and "u" designations (Fields 17 and 18) from the FS 658 card.
21. **Blank field on the card (no title):** Copy the species or the "p," "a," and "u" designations (Fields 17 and 18) from the FS 658 card.
22. **Blank field on the card (no title)**: Record the sum of the well-spaced or free growing trees (including trees over the M value) from the FS 658 card.
23. **Total (W):** If well-spaced indicated in Field 14 (i.e., a stocking survey), record the sum of the well-spaced trees from the Total W (Field 24) of the FS 658 card, not including M's. If free growing is indicated in Field 14 and compiling data for a free growing survey, record the total number of well spaced (free growing plus additional well spaced), ignoring "M."
24. **CW (M's):** If well-spaced is indicated in Field 14 and compiling a stocking survey, record the number of times the M value was entered in the Total W (Field 24) of the FS 658 card. If free growing is indicated in Field 14, and compiling data for a free growing survey, this field will be marked with a "–".
25. **Total (FG):** If free growing is indicated in Field 14 record the sum of the free growing trees from the Total FG (Field 25) of the FS 658 card. If compiling data for a stocking survey, this field will be marked with a "–".
26. **CFG (M's):** If free growing is indicated in Field 14, record the number of times the M value was entered in the Total FG (Field 25) of the FS 658 card. If compiling data for a stocking survey, data will not be recorded in this field.
27. **Total Height (avg. cm):** Record the average height of the sampled well-spaced or free growing trees. This is the sum of the Total Height (cm) (Field 26) from the FS 658 card divided by the number of sample heights recorded.

28. **Age (years):** Record the average age of the sampled well-spaced or free growing trees. This is the sum of the Age (years) (Field 27) from the FS 658 card divided by the number of sample ages recorded.
29. **Plantable (P):** If plantability is selected as an objective on the FS 657 Field 17, record the sum of the Plantable spots (Field 28) from the FS 658 card, not including M's.
30. **CP (M's):** If plantability is selected as an objective on the FS 657 Field 17, record the number of times the M value was entered in the Plantable spots (Field 28) of the FS 658 card.
31. **Total Number "In":** This field is required for multi-storey surveys only. Record the sum of the total trees "in" a prism sweep from all plots on the FS 658 card (Field 28). Can be confused with Plantable data.
32. **BA Modal DiA.:** This field is required for multi-storey surveys only. Record the average modal diameter. This is the sum of all modal diameters, divided by the number of modal diameter recorded.
33. **Preparable (PR):** If plantability is selected as an objective on the FS 657 Field 17, record the sum of the Preparable spots (Field 29) from the FS 658 card.
34. **Target Stocking Standard/ha:** Copy the Target Stocking Standard/ha (Field 43) from the FS 657 card.
35. **Minimum Stocking Standard (p + a) MSS pa/ha:** Copy the Minimum Stocking Standard (well-spaced stems/ha) preferred and acceptable (Field 50) from the FS 657 card.
36. **Minimum Stocking Standard (p):** Copy the Minimum Stocking Standard (well-spaced/ha) preferred (Field 51) from the FS 657 card.
37. **Sum of Well-Spaced or Free Growing without Regard for the "M" Value (TW):** Record the sum of the well-spaced (or free growing trees depending on the primary survey objective) from Field 22.
38. **Species %:** Record the percentage that each species represents. This is the sum of each species from Field 22 of the FS 659, divided by TW (Field 37 of the FS 659).
39. **Sum of Pref. (SPS):** Add the percentage values for each of the preferred species.
40. **Site Index for Leading Silviculture Label Species:** Record the site index of the leading species in the silviculture label. A complete discussion on site index determination can be found on the Ministry of Forests Web site.
41. **Calculations:** Copy the values from the above fields into the correct blanks. Complete the mathematical calculations to determine the number of each item per hectare.

    The following calculations are required for:

ALL surveys	total trees/ha total conifers/ha
STOCKING survey	total well-spaced/ha pa well-spaced/ha total preferred well-spaced/ha.
FREE GROWING survey	countable conifers/ha[a] total free growing/ha pa free growing/ha total preferred free growing/ha
PLANTABILITY survey	plantable spots/ha preparable spots/ha

[a] May be waived by the district manager under certain circumstances.

An alternate method of calculating the minimum number of preferred trees per hectare is currently under review. The issue being discussed is impact of counting past the M value and the effect on subsequent calculations.

One of the acceptable alternate methods is as follows:

$$\frac{\text{Sum of Preferred Trees Not Exceeding M}}{\text{number of plots}} \times 200$$

In certain situations, this proposed alternate method may yield a more favorable result for the prescription holder.

42. **Survey Confidence Limits for Stocking or Free Growing:** Copy the well-spaced or free growing check box (Field 14) from the FS 659 card.
43. **Statistical Calculations:** These fields are provided to record the results of the various statistical calculations required following a survey. The methods are fully described in this document under the section entitled Statistics.

    The FS 1138A card may be used to calculate the Silviculture survey confidence limits.
44. **Stocking Status:** Check the box corresponding to the correct stocking status as determined by this survey.
45. **Compiled by:** Record the name of the person and/or company completing the compilation.
46. **Date Compiled:** Record the date the compilation was completed.
47. **On-Site Cost/ha:** Record the survey cost/ha for the stratum.
48. **Source of Funds:** Record the funding source used to pay for the survey. The Information Management Group maintain the Funding Source Codes.
49. **Inventory Species Composition:** Record the species composition based on the labels from the FS 658 Field 36. The species composition is rounded to the nearest 10%. For further details, see inventory label.
50. **Age (years):** Record the average of the age measurements collected on the FS 658 Field 36. This number must be rounded to a whole number.
51. **Height (m):** Record the average of the age measurements collected on the FS 658 Field 36. This number is expressed in metres and is rounded to the nearest tenth of a metre.
52. **Site Index:** Record the site index for the leading species in the inventory label. A complete discussion on site index determination can be found on the Ministry of Forests Web site.
53. **CRN Clsr:** Crown closure is the average of the various crown closure samples collected as recorded in Field 36 of the FS 658.

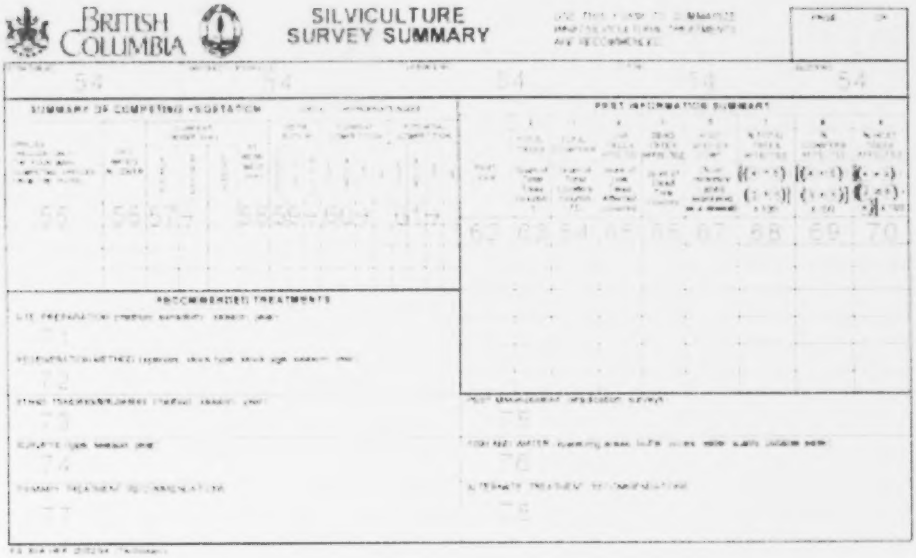


Figure 23. FS 659 Silviculture Survey Summary card (back).

54. **Stratum/Opening/Licence/CP/Block:** Repeat from the front side of the card.
55. **Summary of Competing Vegetation:** Record the species abbreviations from the Competing Vegetation – Species (Field 30) on the FS 658 card. Record the four most significant competing vegetation in this field.
56. **Estimated % Cover:** Record the average percentage ground cover of each of the species listed in the Summary of Competing Vegetation (Field 55). The percentage ground cover of each of the competing vegetation species can be averaged from the Competing Vegetation – % Cover (Field 31) of the FS 658 card.
57. **Current Height (cm) – Minimum, Maximum, Average:** Record the minimum, maximum, and average height of each of the competing vegetation species listed in the Summary of Competing Vegetation (Field 55).
58. **Height Increment:** Record (in centimetres) the average annual height increment of each of the species listed in Field 55.
59. **Distribution – Continuous, patchy, scattered:** Check "continuous," "patchy," or "scattered" when describing the distribution pattern of each of the species listed in Field 55.

    Continuous — brush is evenly distributed over the stratum.

    Patchy — brush-free areas cover approximately the same percentage of ground as brush-covered areas.

    Scattered — brush-free areas are larger than brush-covered areas.
60. **Current Competition – high, medium, low, or nil:** Check the appropriate field when describing the present impact of each of the competing vegetation species listed in the Summary of Competing Vegetation (Field 55).

61. **Potential Competition – high, medium, low, or nil:** Check the appropriate field when describing the potential impact of each of the competing vegetation species listed in the Summary of Competing Vegetation (Field 55).
62. **Pest Code:** Record all the pest codes entered into the Forest Health-Pest Code (Field 33) of the FS 658 card.
63. **Total Trees:** Copy the Total Trees (T) (Field 17) from the FS 659 card.
64. **Total Conifers:** Copy the Total Conifers (TC) (Field 18) from the FS 659 card.
65. **Live Trees Affected:** Record the sum of the live trees affected by each pest code. The number of live trees affected can be found on the Forest Health – Live Trees (Field 34) of the FS 658 card.
66. **Dead Trees Affected:** Record the sum of the dead trees affected by each pest code. The number of dead trees affected can be found in the Forest Health – Dead Trees (Field 35) of the FS 658 card.
67. **Host Species Comp.:** Record the sum of the inventory label species composition of the tree species affected by each pest. This number is expressed as a decimal (i.e., 60% = 0.6).
68. **% Total Trees Affected:** Complete the provided calculations to obtain the percentage of total trees affected by each pest.
69. **% Conifers Affected:** Complete the provided calculations to obtain the percentage of conifers affected by each pest.
70. **% Host Trees Affected:** Complete the provided calculations to obtain the percentage of host trees affected by each pest. This is the number reported in the stocking and free growing reports, on the form C and in ISIS.

Recommended Treatments

When completing treatment recommendations, include specifics such as treatment method, season, and year, and follow-up activities for the recommended treatments. For guidance on completing treatment recommendations, see *Framework for Effective Silviculture Treatment Recommendations* course.

71. **Site Preparation:** If site preparation is recommended, specify the method, type of equipment, site sensitivity, season, and treatment year.
72. **Regeneration Method:** If planting is recommended, specify the species, stock type, stock amount, stock age, season, and treatment year.
73. **Brushing/Stand Tending:** If vegetation management treatments are recommended, specify the method, competing species to be treated, season, and treatment year. If stand tending is recommended, specify the method, species to be treated, season, and treatment year, as well as the post-treatment goals. For spacing, include the characteristics of the species to be left and the target species to be removed. For pruning, include the recommended lift heights for each species to be treated.
74. **Surveys:** If a survey is recommended, specify the type, season, and future survey year.
75. **Pest Management:** If a pest management treatment is recommended, specify the method, monitoring strategies, surveys, target crop species to be treated, target pest species to be treated, and treatment year.

    Recommendations should be based on the forest health treatment thresholds. Refer to Appendix 5 of the *Silviculture Surveys Guidebook*, "Silviculture Survey Forest Health Treatment Thresholds." Consult the district or regional forest health specialists for the most current information.
76. **Fish and Water:** Describe any considerations for fish and water within, or adjacent to, the stratum as it relates to recommended treatments.

77. **Primary Treatment Recommendations**: Provide a summary of the treatment recommendations, including the time frames in which they should occur. Follow the silviculture prescription or the silviculture treatment regime for any recommendations. If there are recommendations in the silviculture prescription or in the silviculture treatment regime that should not be there, bring this to the attention of the holder of the silviculture prescription. An amendment to either the silviculture prescription or the silviculture treatment regime may be required. Any treatment that will overcome the site limiting factors should be considered at this stage. Social or economical factors should be secondary to the biological concerns. All recommendations should be specific, reasonable, timely, and legal.

    It is important that treatment recommendations be directed to establish and encourage preferred species and target stocking standards. *Target Stocking Requirements and Silviculture Treatment Regimes* (Forest Practices Bulletin No. 28) provides additional direction for meeting target stocking standards.

78. **Alternate Treatment Recommendations:** Provide additional treatment regimes to be applied if the primary treatment recommendations cannot be implemented.

5.9 Statistics

Silviculture surveys collect information so that decisions can be made on the stocking status of a stand and so that realistic, sound recommendations can be made for future treatments. Statistics enable surveyors to determine how precisely the survey data describe the stocking (e.g., number of free growing trees per hectare) of an opening.

The following section discusses statistics on free growing tree data. However, these statistical procedures are equally applicable to well-spaced trees. They could also be applied to plantable spots or preparable spots by substituting the corresponding data.

The density and distribution of trees within a stratum vary. Surveyors sample only a portion of that stratum's population. A statistical analysis must be completed to obtain an indication of the variability of the sample population and to provide a measure of the confidence of the average number of well-spaced or free growing trees.

For surveys completed on homogenous strata, the statistical requirements can often be met with very few plots. The Ministry of Forests has set 5 plots per stratum as the minimum recommended number of plots.

Some openings have strata with very high variation in the number and distribution of well-spaced or free growing trees. Because of this high variation, survey calculations might indicate that an inordinate number of plots are required to be established (i.e., 113 plots on a 10-ha stratum). To make the survey both reliable and cost effective, surveyors need not establish more than 1.5 plots per hectare within a stratum.

The recently published Land Management Handbook No. 50, *The Effects of the Silviculture Survey Parameters on the Free Growing Decision Probabilities and Projected Volume at Rotation* discusses, among other issues, the effects that the number of samples has on the risk of misrepresenting the correct stocking status of a stratum. The probability of a not-free-growing stand being called free growing (the Ministry of Forests' risk) is relatively constant as sample size decreases. However, the probability of calling a free growing stand not free growing (the licensee's risk) increases as the number of plots decreases.

5.9.1 Definitions Used in Statistics

n	number of plots	The number of stocking or free growing plots that were established within the stratum.
$\bar{X}$	sample mean or average	For silviculture surveys, this is the mean number of well-spaced or free growing trees found in the survey. This mean should equal the mean found on the FS 659.
s	standard deviation	When calculating the standard deviation, ensure that all individual plots' data with M (the maximum number of well-spaced or free growing trees per plot) are converted to the M value (e.g., M value = 4.5 when TSS = 900).
$s_{\bar{x}}$	standard error	This statistic estimates the standard deviation that would be found if many surveys were done on the same stratum.
t_{90}, n-1	student t-value for 90% confidence with n-1 degrees of freedom	For example, if 10 plots were established, this translates to 9 degrees of freedom.
CI_{90}	Confidence Interval	With repeated surveys of the stratum, 19 times out of 20, the mean plus or minus the confidence interval will contain the population mean
LCL	Lower Confidence Limit	Calculated by subtracting CI from the mean. This statistic portrays the lowest mean that any survey would be expected to find 19 times out of 20. There is only a 5% chance that another survey of the same stratum would find a mean less than the lower confidence interval.
e	desired survey precision	This is the desired survey precision level for a 50 m^2 survey plot. When the calculated mean is greater than 1000 well-spaced or free growing trees per hectare, then the desired precision level is ± 10% ($e = \pm 0.1 * \bar{x}$).
		When the calculated mean is less than 1000 well-spaced or free growing trees per hectare, then the desired precision level is ± 100 trees per hectare ($e = \pm 0.5$ trees/50 m^2 plot).
$n = (t^2 * s^2) \div e^2$		The formula calculates the number of plots necessary to meet desired precision levels using the standard deviation calculated from the survey results thus far.

5.9.2 Importance of Statistical Analyses

The calculation of the standard deviation and confidence interval can indicate

- variability on the estimates of well-spaced or free growing trees;
- if sufficient plots have been established to give reliable estimates of the number of well-spaced or free growing trees per hectare; and
- absence of proper stratification in some areas.

By calculating statistics on uniformly well-stocked strata, surveyors can determine if required confidence levels can be met. This will avoid the establishment of unnecessary plots. As variability increases, the number of plots required to meet desired precision levels also increases.

There is also a strong indication that the establishment of more than 40 plots in a stratum provides very little additional survey precision (Figure 24). If a survey does not meet the desired precision with 40 plots, one of two situations is the likely cause:

- the population itself is variable and additional plots will not produce significantly better results; or
- the stratification is inadequate.

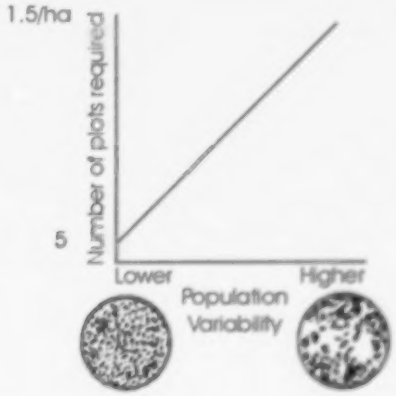


Figure 24. Relationship between population variability and number of plots required.

5.9.3 Calculation Card for Silviculture Survey Confidence Limits (FS 1138A)

The FS 1138A card is used to calculate and document the confidence interval and limits for stocking surveys or free growing surveys. It also provides a standard format within which these calculations can be completed and recorded.

When additional plots are required to meet statistical precision, the FS 1138A will show the statistical calculations from the "first pass." The FS 1138A or the FS 659 will show final confidence limits after the additional plots have been established.

For further information regarding the "two pass" requirements, see Land Management Handbook No. 50, *The Effect of the Silviculture Survey Parameters on the Free-Growing Decision Probabilities and Projected Volume at Rotation*.

5.9.4 Use of the FS 1138B

The FS 1138B card includes a glossary of common statistical terminology. It describes the step-by-step approach to calculating statistics, and it provides a table that lists the number of plots established to the corresponding t value. The t value table is also found on the FS 660. This card also describes the testing procedures to follow when measuring the difference between two means.

5.9.5 Statistical Analysis

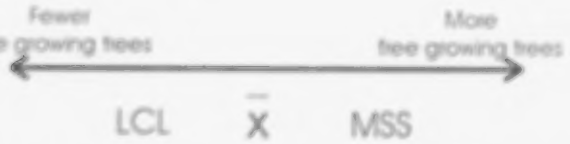
The statistical calculation *must* be done in the field to determine the need for additional plots.

No statistical is analysis required for preferred species alone, only for the combination of preferred and acceptable species.

Where plots have been established, a minimum of 5 plots per stratum is required. More plots, up to 15 plots per hectare, may be required to meet the 90% confidence interval (CI). The following decision rules are to be followed when determining stocking status:

1. If the mean ($\bar{X}$) number of free growing trees per hectare and its 90% lower confidence limit (LCL) are greater than the minimum stocking standard, the area is considered free growing. No further plots are required. There is no need to proceed any further.

2. If the mean ($\bar{X}$) number of free growing trees per hectare is less than the minimum stocking standard (MSS), the area is considered not free growing. No further plots are required. There is no need to proceed any further.



3. The Ministry of Forests will accept a survey mean with a small confidence interval regardless of its lower confidence limit if the confidence interval is less than the Ministry of Forest's desired precision or e value. Two methods are used to calculate the desired precision, or e value:

   (a) **Where $\bar{X}$ is less than or equal to 5** (or 1000 trees per hectare), the desired precision is 0.5 tree per plot, or ± 100 trees per hectare.

   (b) **Where $\bar{X}$ is more than 5** (or 1000 trees per hectare), the desired precision is 10% of the $\bar{X}$

$$(\bar{X}) \times 10\% = e$$

   For example, if the mean number of free growing trees per hectare is 1125, then $\bar{X}$ is 5.625 trees per plot, therefore e is 0.5625 trees per plot or 112.5 trees per hectare.

4. If CI ≤ e, then the survey meets the desired precision; no further plots are required. To determine the stocking status, proceed to step 7.

5. If CI > e, then more plots may be required to meet statistical precision. Proceed to step 6.

6. If $\bar{X}$ is greater than the minimum stocking standard (MSS), but the lower confidence limit is less than the minimum stocking standard, then additional plots must be established to obtain an accurate estimate. The methodology used to determine the number of additional plots necessary to meet precision follows.

To determine the number of additional plots required, use the following formula:

$(t^2 \times s^2) \div e^2 =$ The number of plots required to meet precision

The number of plots required to meet precision - The number of plots already established = The number of additional plots required

☞ No more than 1.5 plots per hectare are required.

As some plots have already been established, subtract the number of plots established from the value derived using the formula. The resulting value is the total number of plots that are left to be established.

If the formula indicates more than 1.5 plots per hectare, only establish 1.5 plots per hectare. Conversely, if the value derived from the formula indicates less than 1.5 plots per hectare, establish only the number of plots required by the formula.

Where the initial plots are established in a systematic pattern it is equally acceptable to establish the additional plots on either a single diagonal line that extends across the stratum, or between existing plots on a systematic basis.

In Figure 25, the original plots are circles. The additional plots required to meet statistical precision are squares.

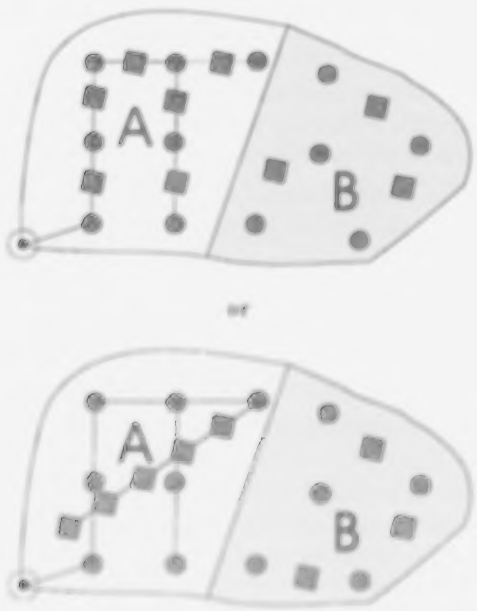


Figure 25. Example of location of additional plots to meet statistical precision

7. Recalculate the statistics as a final evaluation of the sample population. However, the stocking decisions are now completed based on the comparison of $\bar{X}$ and MSS. If $\bar{X}$ is greater than or equal to MSS, the stratum is free growing; if not, the area is not free growing.

5.9.6 Multi-storey Statistics

Confidence limits do not apply to multi-storey surveys. Some districts may request that surveyors calculate statistics for a particular layer and establish additional plots as required. Surveyors should consult with the district to confirm their requirements. Currently, there are no provincially approved or required methods for statistical analysis on multi-storey surveys.

5.10 Treatment Recommendations

The *Forest Practices Code of British Columbia Act* does not require treatment recommendations. However, the Act does require results-based surveys. These results are based on sound treatment recommendations. Surveys conducted by the Ministry of Forests under the FS 925A (*Silviculture Contract for Silviculture Surveys*) do require treatment recommendations. Many licensees may use a similar contract.

To develop treatment recommendations, compare the results of the survey to the standards and the management objectives in the silviculture prescription or the silviculture treatment regime. Where the present opening fails to meet those standards or management objectives, treatments or actions need to be recommended that will enable the opening to meet those objectives. Effective treatment recommendations are ones that are ecologically suited to the opening, are cost effective, will result in a free growing stand within the prescribed time frames, and will provide for management of preferred and acceptable species at target stocking levels. Recommendations may also include suggestions for amending the silviculture prescription or the silviculture treatment regime. For each opening, an alternative recommendation should be included. Where applicable, treatment recommendations should include a brief explanation supporting the recommendations made.

Several factors should be considered when making treatment recommendations:

- Do the data collected and summarized support the visual observations?
- Is a treatment required to meet the regeneration date?
- Is a treatment required to assure a free growing stand within the prescribed free growing time frame?
- Are the recommended treatments cost effective?
- Are the recommended treatments feasible?

Treatment recommendations should be SMART:

Succinct
Measurable
Achievable
Relevant
Timebound

The SMART concept and a detailed description of the steps required to develop silviculture treatment recommendations are discussed in the *Framework for Effective Silviculture Treatment Recommendations* course.

The first step in creating treatment recommendations is to compare the survey data to the standards in the silviculture prescription, the silviculture treatment regime, and the contract. The data collected during the survey should reflect the standards set out in the silviculture prescription and in the contract.

The next step is to identify any deficiencies noted in the survey. For example, is the stratum SR or NSR? If no treatments are required, then there are no recommendations to be made.

Every site has limiting factors such as climate, forest health, competing vegetation, or nutrients. The next step is to incorporate the limiting factors into the suggestions.

For each deficiency or limiting factor found in the survey, consider possible solutions. At this point, consider every solution, regardless of feasibility or cost-effectiveness. Always aim for the target standards, not the minimum standards. Where possible, try to meet the silviculture prescription requirements. This may not always be possible, and amendments may be necessary.

If the standards in the silviculture prescription cannot be met, the surveyor may recommend that an amendment be made to bring the silviculture prescription more in line with what is actually on the site. When making recommendations for amendments, be specific as to what needs amending. Only recommend amendments for deficiencies that cannot be fixed otherwise.

Some of the types of treatments that surveyors can recommend include:

- site preparation
- planting
- juvenile spacing
- brushing
- sanitation

5.11 Reports

Only surveys used to support the fulfillment of stocking requirements (e.g., regeneration date and free growing stand) need to be formally reported. Reporting other intermediate surveys is not required.

It is essential to keep a written record of the survey (e.g., the FS 657, FS 658, and FS 659) and the results, and provide these to the district manager if requested.

Where a district manager is not satisfied with the survey, a notice will be issued indicating why the area is to be resurveyed and the time in which it must be completed.

A few different categories of survey reports should be considered:

- stocking surveys
- free growing surveys
  - with regeneration objectives (most common)
  - without regeneration objectives
- compliance report required by the government

5.11.1 Stocking Survey Reports

A stocking survey report has few mandatory items. The Silviculture Practices Regulation requires that the number of healthy, well-spaced trees per hectare be reported on or before the regeneration date specified in the silviculture prescription. The Form C report with an accurate map showing the silviculture

treatments applied and a map notation that includes a description of the forest cover by species, height, age, density, and site index is also required. The regulations require these reports be submitted on or before May 31, in the year following the survey.

Surveys used to show compliance with stocking standards must be carried out to the satisfaction of the district manager. The silviculture survey cards and summaries shall be made available for auditing at the request of the district manager.

5.11.2 Stocking Survey Reports on Woodlots

The Woodlot Licence Forest Management Regulation Section 88 (2) specifies only that an assessment be undertaken that will show whether the stocking requirements have been met, and later in the regulation that the assessment be completed to the satisfaction of the district manager.

The report is submitted as part of the annual report.

5.11.3 Free Growing Survey Reports for Areas with Regeneration Objectives

A report on the free growing survey may be required and must be submitted if requested by the district manager. Guidance can also be found in the Forest Practices Branch General Bulletin No. 39, *Free Growing Declaration and Acknowledgement*.

The submission must contain the following:

- the identification of the area under the silviculture prescription
- the agreement number
- the name of the holder of the agreement
- for the net area to be reforested:
  - the area
  - the biogeoclimatic ecosystem classification (to the site series level)
  - the number of healthy, well-spaced, preferred and acceptable free growing trees per hectare
  - the number of healthy, well-spaced, preferred free growing trees per hectare
  - the incidence of damage caused by forest health factors
  - the total number of countable coniferous trees per hectare for the purpose of determining compliance with the maximum number of coniferous trees allowed per hectare under the prescription
  - identification of areas that are: free growing (FG) satisfactorily stocked (SR) and not satisfactorily restocked (NSR)
  - the inventory label and silviculture labels including species, age, height, density, and site index

The Silviculture Practices Regulation requires licensees to submit a signed and sealed declaration when a stand is free growing. The free growing declaration must follow and reflect the results of the survey.

5.11.4 Free Growing Survey Reports for Areas without Regeneration Objectives

Guidance can also be found in the *Free Growing Declaration and Acknowledgement* (Forest Practices Bulletin No. 39).

The submission must contain the following:

- the identification of the area under the silviculture prescription and, if the report is required of a holder of a major licence, the agreement and the name of the holder of the agreement
- for the net area to be reforested:
  - the area
  - the biogeoclimatic ecosystem classification
  - the incidence of damage by forest health factors affecting trees
  - the inventory label, including species component, age, height, density, basal area, and site index
  - the number of acceptable and preferred trees per hectare
- The requirement to submit a declaration and a Form C is the same as stated for areas with regeneration objectives.

5.11.5 Free Growing Surveys for Intermediate Cuttings on Woodlots

Between 1 and 3 years following the completion of harvesting, the woodlot licence holder is responsible to conduct a survey of the following:

- the identification of the area;
- the inventory label, including species component, age, height, density, and site index
- the incidence of damage by forest health factors affecting trees

The report is submitted as part of the annual report.

5.11.6 Compliance Report Required by the Government

Where the government is required to produce a free growing stand, district managers, through their staff, are also responsible to maintain records. This is currently done via data entry into ISIS. Annual reports are generated to identify the level of compliance.

5.11.7 Free Growing Surveys on Woodlots

The free growing assessment requirements are similar to those of the major licence holders.

- identification of the area
- the number of healthy, well-spaced, free growing preferred and acceptable trees per hectare
- the number of healthy, well-spaced, free growing preferred trees per hectare
- the total number of countable coniferous trees per hectare for the purpose of determining compliance with the maximum number of coniferous trees allowed per hectare under the prescription
- the inventory label and silviculture labels including species, age, height, density, and site index
- identification of areas that are:
  - satisfactorily stocked (SR)
  - not satisfactorily restocked (NSR)

The report is submitted as part of the annual report.

5.11.8 Inventory Label

An inventory label is a standardized method of describing the commercial tree species growing on an opening. Surveyors make ocular estimates of the species composition (to the nearest 10%), and the average height and age of the dominant and co-dominants of the leading and second species and crown closure. In practice, this means surveyors will visually gather these data from within the stratum as they conduct the survey. These estimates are collected at the first and every fourth plot thereafter. Where few plots are established in a large stratum, inventory label data should be recorded more often.

The density is based on plot data. Site index, depending on the method described on the FS 657, may (growth intercept) or may not (SIBEC) be based on plot information.

The sample inventory label describes a stratum with the following characteristics:

$$Fd_6Lw_3At_1 - 9/8 - 1.9/1.8 - 26 - 12 - 2280/0(04)(7)$$

- species composition of the total trees is Douglas-fir 60%, western larch 30%, and aspen 10%
- average age of dominant and co-dominant Douglas-fir is 9 years, and western larch is 8 years
- average height of dominant and co-dominants: Douglas-fir is 1.9 m and western larch is 1.8 m
- site index of the leading species: Douglas-fir is 26 m at 50 years
- crown closure of all the commercial tree species is 12%
- total trees per hectare is 2280
- dbh limit for the number of total trees per hectare represents those 0.3 m or the minimum height specified for the survey. Refer to the Terrestrial Information Branch of the Ministy of Sustainable Resource Managementfor more information about the dbh limit codes.
- year of the survey is 2004
- code 7 indicates that the source of the information in the inventory label is a silviculture survey. A complete list of the data source class codes is found at the Terrestrial Information Branch of the Ministry of Sustainable Resource Management.

5.12 Silviculture Label

A silviculture label is a standardized format of the string of data that describes the wel-spaced or free growing component of a stratum. Most of the data items are selected from the FS 659 summary card when plots are established. When no plots are established, the entire label can be generated from visual observations, but should be done with extreme caution and only by very experienced surveyors.

The sample silviculture label describes a free growing stratum with the following characteristics:

$$Fd_{66}Lw_{14}Pl_{10}Sx_{10} - 9 - 1.9 - 26 - 1040(04)(7)$$

- species composition of the free growing trees is Douglas-fir 66%, western larch 14%, lodgepole pine 10%, and spruce 10% (based on total free growing disregarding the M value)
- average age of all species of free growing trees is 9 years
- average height of all species of free growing tree is 1.9 m
- site index of the leading species, Douglas-fir, is 26 m at 50 years
- free growing trees per hectare is 1040 (based on the calculations completed on theFS 659 with the M value)
- year of survey is 2004

- code 7 indicates that the source of the information in the silviculture label is a silviculture survey. A complete list of the data source class codes is found at the Terrestrial Information Branch of the Ministry of Sustainable Resource Management.

When completing the silviculture label for a free growing survey, the label components (e.g., species, age, height) refer to free growing trees per hectare only if the stand has achieved free growing status as determined by the survey. Otherwise, the well-spaced values are used in creating the silviculture label.

5.13 Forest Cover Attribute Forms

Completed forest cover attribute forms may or may not be required by individual licensees and forest districts. Surveyors should be aware that the data they collect and summarize are transferred to the Ministry's databases via these forms.

Three Ministry of Forests forms are currently available for summarizing forest cover and compliance data: FS 922, FS 810A, and FS 708C. Most of the data recorded on these forms is taken from the FS 659 cards. The FS 659 summarizes data from all the plots within a stratum. The FS 922, FS 810A, and FS 708C forms summarize the data from all of the strata within a given opening, regardless of when they were last surveyed.

The surveyor should check with each district before compiling forest cover data to determine which form the district requires for openings under district responsibility. Licensees using Major Licensee Silviculture Electronic Data Transfer (MLSEDT) to submit forest cover data will not use an attribute form.

The FS 922 and FS 810A forms summarize forest cover and compliance data for openings in which the Ministry of Forests holds the management responsibility. Data from either of these forms are entered into ISIS (the Ministry's Integrated Silviculture Information System). Forest cover inventory data are then entered into FCAPS, the system currently used to update forest cover maps and timber supply data.

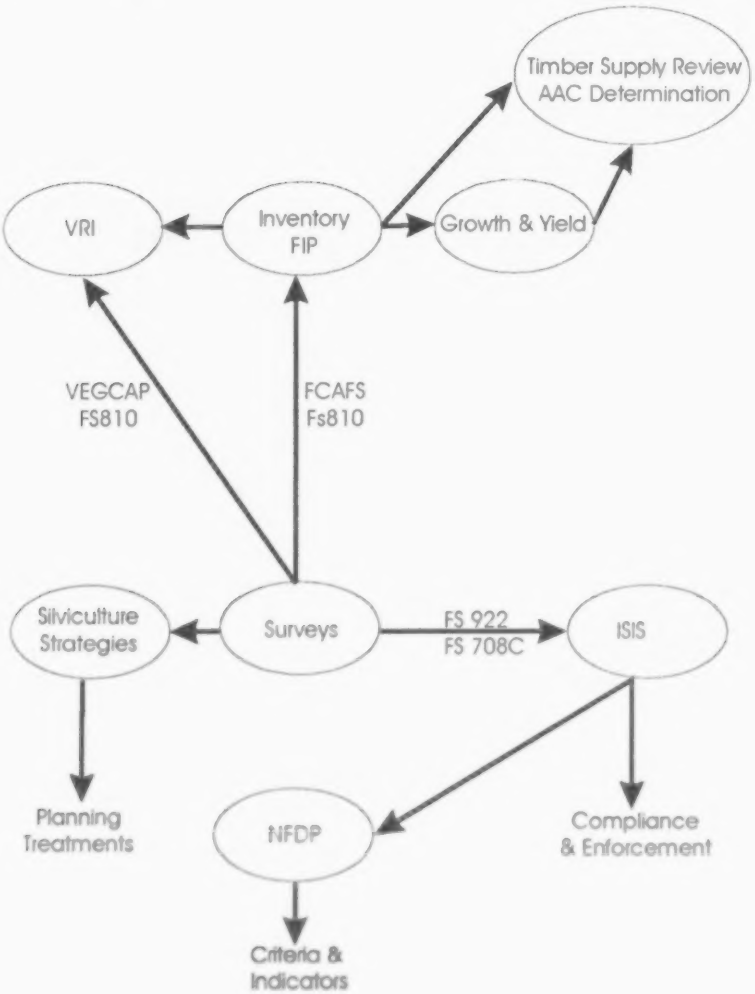
The FS 708C accommodates data entry into ISIS and FCAPS. It is similar to the FS 922 and FS 810A although somewhat abbreviated. The intent of this form is to provide the inventory and silviculture data to the Ministry of Forests in a standard, easy to keypunch manner. For details on how to complete the FS 708C, see *Guide to Completing FS 708 Forms*. The purpose of a forest cover attribute form is to summarize silviculture survey data in a consistent and standardized method. These data are then transferred to the provincial databases.

The Ministry of Sustainable Resource Management, Terrestrial Information Branch, and tree farm licence (TFL) holders maintain a computer database. This database contains the forest inventory attributes for each forest type (polygon) and for each opening.

Information regarding species composition and treatments is found on the forest cover and history attribute lists for each polygon.

This information is used to:

- determine allowable annual cuts for timber supply areas
- determine growth projections of stands
- complete long-term planning and yield analysis
- identify various harvest opportunities
- identify stand management opportunities



5.14 Provincial Accreditation and Training

In the 1980s, a silviculture survey certification and training process was developed for British Columbia with the goal of ensuring quality silviculture surveys. However, surveyors and survey contractors were dissatisfied with the process of certification and with the structure of the intensive 5-day training course, followed by an exam. In 1995, the certification process changed to an accreditation process. This separated the training components from the examination.

Although there are no legal requirements for surveyors to be accredited, an accredited surveyor has a higher probability of meeting the Silviculture Practices Regulation Section 24 requirement to "carry it out to the satisfaction of the district manager." Many silviculture contracts specify the involvement of one or more accredited surveyors.

There are no prerequisites for the silviculture surveyor accreditation exam. However, the average surveyor requires considerable field experience working under the guidance of experienced accredited

surveyors before successfully completing the exam. To pass the examination, a person will need to meet a range of performance expectations as outlined in the *Silviculture Surveys Accreditation Program* brochure produced by the Ministry of Forests.

To ensure that surveyors have sufficient opportunity to acquire the needed skills and knowledge required for accreditation, the Ministry of Forests is developing Web-based training modules. These modules will also be available through educational institutes throughout the province.

Accreditation exams are usually offered at the beginning and at the end of each field season. Dates and locations of the exams will be advertised on the Ministry of Forests Web site.

The accreditation process provides no assurance that the survey work completed by any one person, or that any particular survey, is done to the recommended standard. It is not a replacement for diligent supervision and auditing. Each surveyor is responsible for keeping informed of any changes to standards and procedures.

For more information on the silviculture surveyor accreditation process, contact the silviculture surveys program administrator at the Ministry of Forests Forest Practices Branch office by calling Tania Johnson (250) 356-2094 or Paul Rehsler (250) 387-8908, by faxing (250) 387-1467, or by visiting the Ministry of Forests Web site.

Appendix 1. Glossary

Acceptable species: Acceptable species are ecologically suited to the site, but management activities are not aimed at establishing them. The reasons for including a species in this category may be increased site limitations, such as pest risk, for biodiversity.

Activity treatment unit (ATU): An area of land upon which a silviculture activity is planned and carried out, usually within the boundary of an opening (also see Treatment Unit).

Advance regeneration: Regeneration that was present on an opening before harvesting. Advance regeneration, if present, should be carefully evaluated to determine its potential for future management.

Age class: Any interval into which the age range of trees, forests, stands, or forest types are divided for classification and use. Age class is defined by Resource Inventory Branch as groups of 20 years: 1 = 1-20, 2 = 21–40, etc.

Aspect: The direction toward which a slope faces.

Backlog area: The *Forest Practices Code of British Columbia Act* defines a backlog area as "an area, from which timber was harvested, damaged or destroyed before October 1, 1987, and that, in the district manager's opinion, is insufficiently stocked with healthy, well-spaced trees of commercially valuable species."

Bareroot seedling: Seedlings that are grown in nursery seedbeds before planting.

Basal area (BA): The cumulative cross-sectional area of trees as measured at breast height. The calculation of the basal area can be derived using the following formula:

Average number of trees per plot found "in" a prism sweep × BAF of the prism used

Basal area factor (BAF): The factor used to multiply the number of trees found "in" during the prism sweep to yield the basal area per hectare. For example, with a BAF of 5, each tree found within the prism sweep represents 5 m^2/ha of cumulative cross-sectional area.

Basal resinois: Large exudations of pitch at the base of the stem, found at or below the root collar. This symptom is often associated with Armillaria root disease, or Warren's root collar weevil.

Basic silviculture: The silviculture treatments that are carried out to ensure regeneration to the free growing stage.

Biodiversity The full spectrum of flora and fauna that occurs in a geographic area. Biodiversity includes species diversity, genetic diversity, and ecosystem diversity.

Biogeoclimatic classification: Ecosystem classification on the basis of vegetation, soils, topography, and climate.

Biogeoclimatic zone: A geographic area having similar patterns of energy flow, vegetation, and soils as a result of a broadly homogenous macroclimate. Biogeoclimatic zones are typically named after one or more dominant climax tree species occurring on zonal sites. The names often include a geographic or climatic modifier using the terms subzone, variant, site series, site type, and site phase.

Breast height (b.h.): The standard height (1.3 m above the point of germination) at which the diameter of a standing tree is measured.

Brush blade: A straight blade with curved teeth extending below the blade like a rake. The blade is mounted on the front of a prime mover, such as a crawler tractor or a skidder, for use in mechanical site preparation.

Brushing: A silviculture treatment to remove broadleaf species, shrubs, or herbs that compete with conifers for sunlight, water, and soil nutrients.

Buffer strip: A strip of land where disturbance is either not allowed or the disturbance is closely monitored to preserve or enhance aesthetic and other qualities along or adjacent to roads, trails, watercourses, and recreation sites.

CASI: Compact Airborne Spectral Imagery.

Chlorosis or chlorotic: Blanched or yellowish colouring of normally green foliage in plants, caused by a variety of factors, including nutrient or light deficiencies.

Clearcutting: A silvicultural system resulting in the harvesting of all trees from an area of forest land in a single cut.

Clinometer: An instrument for measuring vertical angles or slopes commonly used to calculate tree heights.

Co-dominant: In upper stands with a closed canopy, those trees whose crowns form the level of the canopy and receive full light from above, but comparatively little from the sides. In young stands, co-dominant trees have above average height growth.

Commencement date: This term is defined by Section 70(1) of the *Forest Practices Code of British Columbia Act*. There are specific interpretations of the definition suited to the context where it is being applied. The two most common definitions are as follows.

1. The date when harvesting, excluding road and landing construction, begins on the area under the silviculture prescription.
2. In the case of silviculture prescriptions on backlog areas, the commencement date is defined as the date that any silviculture treatment (e.g., site preparation) under the backlog silviculture prescription begins (Section 23 of the *Forest Practices Code of British Columbia Act*).

Commercial thinning: The thinning of older immature stands where trees have reached merchantable size, to provide an interim harvest and a financial return while maintaining or restoring a higher rate of growth on well-spaced, better quality final crop trees.

Competing vegetation: Vegetation that competes for the limited common resources (space, light, water, and nutrients) of a forest site that are otherwise needed for survival and growth by commercially valuable preferred trees.

Conifer: Cone-bearing tree having needles or scale-like leaves, usually evergreen, and producing wood known commercially as softwood.

Container seedling: Seedling grown in small containers in a controlled nursery environment.

Countable conifer: Conifers meeting or exceeding a minimum countable height and counted towards the maximum density determination during a free growing survey. See also Maximum density.

Countable height: The height above which all trees are tallied and considered as countable conifers. Currently, for a coniferous tree to be considered as a countable conifer for determining maximum density, it must be taller than 20% the height of the median well-spaced trees selected in the plot. Where the number of well-spaced trees exceeds the M value, use the median height of the tallest trees equal to the M value. A countable conifer is also considered as a countable conifer for determining maximum density if it meets height criteria specified by the chief forester.

Crop tree: A tree in a young stand selected to be retained until final harvest.

Crown closure: The stand condition resulting in the crowns of trees touching and effectively blocking sunlight from reaching the forest floor. Crown closure is expressed as a percentage.

Cutblock: A specific area with defined boundaries authorized for harvest.

Danger tree: Any tree that is hazardous to people or facilities because of its location, degree of lean, physical damage, overhead hazards, limb, stem, top or root system deterioration, or a combination of any of these. If work in a forestry operation will expose a worker to a dangerous tree, the tree must be removed.

DBH (diameter at breast height): The stem diameter of a tree measured at breast height, 1.3 m above the point of germination.

Decay: The disintegration of plant tissue. The process by which sound wood is decomposed by the action of wood-destroying fungi and other micro-organisms.

Deciduous: Term applied to trees, commonly broadleaf trees, which usually shed their leaves annually. Also known commercially as hardwoods.

Declination (magnetic): The angle between true north and magnetic north. Declination varies from place to place and can be set on a compass for a particular location.

Defoliator: An agent that damages trees by destroying leaves or needles.

DIB (diameter inside bark): The diameter of a tree or log excluding bark thickness.

Disc trencher: A machine designed for mechanical site preparation. Disc trenchers consist of rotating scarifying steel discs equipped with teeth that create rows. The discs are attached to the rear of a prime mover such as a skidder.

Dominant: Trees with crowns extending above the general level of the canopy and receiving full light from above and partly from the side. Dominant trees are taller than the average trees in the stand, with well-developed crowns.

Drag scarification: A method of site preparation. The objective of drag scarification is to disturb the forest floor and to prepare harvested areas for natural regeneration. Drag scarification is done with anchor chains or sharkfin barrels. These tools are large, specially constructed steel chains that are dragged behind a prime mover such as a skidder.

DSH (diameter at stump height): The diameter of a tree, as measured at 30 cm above the point of germination. Also referred to as DBHg, diameter at ground.

Ecosystem: The sum of plants, animals, environmental influences, and their interactions within a particular habitat.

EDT: Electronic data transfer.

Even-aged: A forest stand or a forest type in which relatively small (10–20 year) age differences exist between individual trees. Even-aged stands are often the result of fire, or a harvesting method such as clearcutting, or the shelterwood method.

FCAPS: Forest Cover Attribute Processing System.

Fertilization: The addition of fertilizer to promote tree growth on sites deficient in one or more soil nutrients. Commonly used to improve the vigor of crop trees following juvenile spacing or commercial thinning.

FC1: The digital map files of forest cover maps (i.e., 93B035 FC1). This file contains the forest cover map data for mapsheet 093B035.

FG: Free growing.

Fill planting: Supplementary planting required to augment poorly stocked natural regeneration, or to replace seedlings that have died on previously planted sites.

FIP file (Forest Inventory Planning): This is a digital file containing the information that describes all attributes relating to a polygon, as well as layer and history information.

Forest cover labels: A combination of letter and number codes in a sequential order that describes the forest cover characteristics.

Forest cover map: A map showing relatively homogenous forest stands or cover types produced from the interpretation of aerial photos and from information collected from field surveys. Commonly includes information on species, age class, height class, site, and stocking level.

Forest ecology: The relationship between forest organisms and their environment.

Forest health factor: Biotic or abiotic influences on the forest that are usually naturally occurring components of forest ecosystems. Biotic influences include fungi, insects, plants, animals, bacteria, and nematodes. Abiotic influences include frost, snow, fire, wind, sun, drought, nutrients, and mechanical human caused injury.

Forest health pest: A forest health factor that limits the ability to meet resource management objectives.

Forest licence (FL): A forest licence is a form of tenure that allows the orderly timber harvest over a portion of a sustained yield management unit. The forest licence provides for the timely reforestation of these harvested areas according to a strategic resource management plan prepared by the Ministry of Forests for each timber supply area. The licence commonly has a term of 15 to 20 years, generally replaceable every 5 years (some are non-replaceable). The operating areas shift over time. A forest licence specifies an allowable annual cut, and requires a management and working plan, and specified management activities.

Forest Practices Code (FPC): The Forest Practices Code is a term commonly used to refer to the *Forest Practices Code of British Columbia Act*. This also includes regulations by Cabinet under the Act and the standards established by the chief forester of British Columbia. The term may sometimes be used to refer to guidebooks. However, unlike the Act, the regulations, and the standards, guidebooks are not legally enforceable.

Fork: A deformation of the main stem resulting in two or more leaders.

FPC: Forest Practices Code.

Free growing stand: A stand of healthy trees of a commercially valuable species, the growth of which is not impeded to an unacceptable level by competition from plants, shrubs, or other trees.

Free growing tree: A healthy, preferred, or acceptable well-spaced tree that is at least the minimum height, and is at least the minimum size relative to competing vegetation within the effective growing space.

Fruiting body: The reproductive part of a fungus that contains or bears spores.

Gall: Nodule or lump of malformed bark or woody material caused by a variety of factors such as western gall rust, or insects.

Galleries: Passages carved out under bark or in wood by insects feeding or laying eggs.

Ghost tree: Tree that, for a specified reason, will not count towards the stocking of the stand but has an impact on the development of the regeneration.

GI: Growth intercept.

Girdling: To kill a tree by severing or damaging the cambium layer and interrupting the flow of nutrients between the leaves and the rest of the tree. Girdling is carried out using a hatchet or special tool to cut through the bark and the cambium.

Global Positioning System (GPS): A navigational tool that allows users to determine their location on the surface of the earth. The location is determined using a hand-held or aircraft-mounted instrument and the radio signals from several satellites.

Gouting: Excessive swelling of a branch or shoot, often accompanied by misshapen needles and buds. Gouting is most common at nodes or on branches, and is frequently caused by balsam woolly adelgid on *Abies* species.

Growing season: The period of active growth from the start of bud elongation until bud set.

ha: Hectare.

Hack and squirt: A method of killing a tree. The bark of the tree is cut (hack) and herbicides are injected into the wound (squirt).

Height class: Any interval into which a range of tree heights is divided for classification and use.

Herbicide: Chemical substances or living organisms that are used to kill or to control vegetation such as brush, weeds, and competing or undesirable trees.

Immature: Trees or stands that have grown past the regeneration stage, but are not yet mature.

Incidence: The proportion (0 to 1) or percentage (0 to 100) of entities (normally a tree) affected by forest health factors within a sample unit. This can easily be referred to as the proportion or percentage of forest health factors present within an opening.

INCOSADA: Integrated Corporate Spatial and Attribute Database.

Incremental silviculture: Treatments carried out to maintain or to increase the yield and the value of forest stands. Treatments include site rehabilitation, conifer release, spacing, pruning, and fertilization.

Indicator species: Plant species used to predict site characteristics with respect to site moisture and site nutrients in the biogeoclimatic classified system.

Infections: Characterized by lesions on the stem and/or branches, or characterized by swellings around the point of entrance of a pathogen.

Influence trees: Trees growing outside the plot radius whose effective growing space projects inside the plot radius.

Injury: Damage to a tree by a biological, physical, or chemical agent.

Inter-tree distance: The horizontal distance between two trees on a centre-to-centre basis. Inter-tree distance is calculated or measured to the nearest 1/10 of a metre, unless otherwise specified.

Intermediate cut: Stand entries to remove (usually merchantable) trees before the final harvest or regeneration cut phase. Usually designed to modify the stand so that continued stand development enhances the quality or growth of established trees.

ISIS: Integrated Silviculture Information System.

Juvenile spacing: A silviculture treatment resulting in the reduction in density of young stands, preferably between 3 and 5 m in height, to control stocking, prevent stagnation, and improve crop tree quality so that at final harvest end-product quality and value are increased.

Landing: The area where logs are collected for loading.

LCL: See Lower confidence limit.

Leader: The annual growth of the apical meristem of a tree. It is the extension of the main stem.

Leave trees: Trees selected to be left on an area following harvesting, juvenile spacing, or commercial thinning.

LFH (litter-fermentation-humus): The accumulation of organic material over mineral soil. L, F, and H refer to litter, fermentation, and humus, respectively.

Licensee: Tenure holder. See Tenure.

Lower confidence limit: This statistical value indicates the lowest average number of well-spaced trees per hectare that another survey on the stratum would be expected to find, 9 times out of 10. The LCL of 90% must be attained before the opening can be considered satisfactorily restocked or free growing.

Mature: Trees or stands that have sufficiently developed to be harvested.

Maximum density: The maximum allowable stand density of total countable conifers, above which openings must be spaced down to a specified density of well-spaced preferred and/or acceptable stems, to achieve free growing status.

Median height: The middle height. Used in the countable conifers and countable broadleaf determination. Refer to Figure 19 and Figure 20 for illustrations of this concept.

Mesic: Within the biogeoclimatic classification system, mesic sites are those that are most common (average) within a single zone. It may also be referred to as zonal.

Microclimate: The climate of small areas, especially if it differs significantly from the climate of the region.

Microsite: A small area exhibiting specific characteristics that are different from the surrounding area. During planting projects, microsite is commonly referred to as "acceptable microsite." Acceptable microsites are those spots that are best suited for the optimum survival and growth of the planted tree.

Minimum height at free growing: The minimum height that a healthy, well-spaced tree must attain to be considered free growing. On areas for which a silviculture prescription was approved on or after April 1, 1994, minimum heights vary by species, biogeoclimatic zone, and site series.

Minimum inter-tree distance (MITD): The minimum horizontal distance between two trees on a centre-to-centre basis. Inter-tree distance is calculated or measured to the nearest 1/10 of a metre, unless otherwise specified.

Minimum preferred stocking standard (MSSp): The minimum number of well-spaced trees per hectare, of preferred species only, that must be present for the stratum to be considered satisfactorily restocked or free growing.

Minimum stocking standard (MSS, MSSp+a): The minimum number of well-spaced trees per hectare, of preferred and acceptable species, that must be present for the stratum to be considered satisfactorily restocked or free growing.

MLSIS: Major Licensee Silviculture Information System. In the late 1990s, this system was integrated into ISIS.

Modal diameter: Used in multi-storey surveys, modal diameter is the most frequently observed diameter of the trees found within the prism sweep. This is not the average diameter of all the trees. In the following list of diameters, 24 is the mode: 16, 27, 24, 38, 24, 27, 24, 25.

Moder: A humus form characterized by a greater than 1 cm thick F horizon and an Ah layer. Typically, soil organisms are responsible for the intermediate decomposition rates through soil mixing.

MOF: Ministry of Forests.

Monoculture: Cultivation of a single tree species.

Mor: A humus form characterized by a greater than 1 cm thick F horizon and an absent Ah layer. Typically, decomposition is slow due to a lack of soil organism.

Mosaic: Distinct strata that occur in a dispersed manner.

MSS: Minimum stocking standards.

Mull: A humus form developing under conditions that favour rapid decomposition of organic matter. F layers are generally less than 1 cm thick, Ah layers are greater than 2 cm thick, and extensive soil mixing is caused by soil organisms.

Multi-storey: A stand is considered multi-storied if layer 1 and/or layer 2 have a crown closure greater than 6%, and one of these two layers is considered in combination with layer 3 and/or layer 4.

M value: The maximum number of healthy, well-spaced trees that may be tallied in a single plot. This value is calculated by dividing the target stocking standard for the stratum by the plot multiplier. This prevents overstocking in one plot compensating for understocking in others. This is a key concept in the survey system.

NAR: Net area to be reforested.

Natural regeneration: The renewal of a tree crop by natural means.

NCBr: Non-commercial brush.

Net area to be reforested (NAR): The area on which the licensee is responsible for establishing a free growing crop of trees. This figure is the sum of Standards Unit (SU) areas. The NAR does not include any human-caused non-productive areas, reserves of immature trees, and natural non-productive areas that are large enough to stratify and map, as well as non-commercial brush areas greater than 4 ha that are not deemed to be the obligation of the licensee. Non-productive or non-commercial areas that are too small to stratify are included in the SU area.

Node: A joint or portion of a stem from which a leaf or branch has grown.

Non-commercial brush (NCBr): Describes a potentially productive forest site that is occupied by shrubs and other deciduous species that are not used commercially.

Non-productive (NP): Land that is incapable of growing a merchantable stand of trees within a reasonable length of time.

Not FG: Not free growing.

Not satisfactorily restocked (NSR): Productive forest land that has been denuded and has not been regenerated to the specified stocking standards for the opening.

No-work zones: Areas in which equipment and people are not allowed during forestry operations, usually for safety or ecological reasons.

NP: Non-productive.

NSR: Not satisfactorily stocked.

Opening: An area denuded of trees due to harvesting, insects, disease, fire, wind, flooding, landslide, or any other similar events.

Overmature: Those trees or stands past the mature stage that commonly have a higher level of damage and decay.

Overtopping: Vegetation that is taller than the crop species within a 1-m radius around the crop species.

Pesticides: A general term for chemicals used to kill either vegetative pests (herbicides) or insect pests (insecticides).

PHSP: Pre-harvest silviculture prescription.

Plantable spot: A suitable microsite on which a seedling could be planted. The suitability of the microsite depends on site conditions and limiting factors such as soil moisture, soil temperature, soil nutrients, climatic conditions, tree species, and stock type to be planted.

Plantation: A human-made forest, usually established by planting seedlings.

Planting (artificial regeneration): Establishing a new stand by planting seedlings or by direct seeding, as opposed to natural regeneration.

Plot multiplier: The factor used to multiply the tree count in the survey plot to yield the equivalent stems per hectare. It is calculated by dividing the area of 1 ha (10 000 m^2) by the area of the sample plot. For example, a plot radius of 3.99 m has an area of 50 m^2 and a resulting plot multiplier of 200 (10 000 m^2 ÷ 50 m^2 = 200).

Plug: A seedling grown in a small container under carefully controlled nursery conditions. When seedlings are removed from containers for planting, the nursery soil remains bound up in their roots.

Point of commencement (POC, P of C): This term is used to describe "the starting place" of a survey. POCs should be tied into features indicated on the forest cover map or on an air photo (e.g., road junctions, creek crossings or junctions, or block boundaries).

Population: Consists of the total number of the observations with which we are concerned (e.g., all the well-spaced trees in an opening).

Preferred species: Those species that are ecologically suited to the site. Management activities are primarily aimed at establishing preferred species. The characteristics of these species are consistent with the desired timber and non-timber objectives for the opening.

Pre-harvest silviculture prescription (PHSP): A legally binding, site-specific plan describing the nature and extent of any timber harvesting and silviculture activities carried out on an opening. The PHSP outlines the required management objectives, standards, and timelines that the owner of the opening must achieve, including reaching a free growing stand. PHSPs are the "pre-Forest Practices Code" equivalent to silviculture prescriptions. With the initiation of the Forest Practices Code, all PHSPs will be treated in the same manner as silviculture prescriptions.

Preparable spot: A microsite that is presently unsuitable for planting but, with site preparation, would become an acceptable planting microsite.

PRF: Plot radius factor.

Prime mover: Heavy equipment used to tow other machines such as disc trenchers for site preparation.

Prism: An optical instrument consisting of a thin wedge of glass. The prism creates the appearance that part of the object being looked at is laterally displaced. If the object and the displaced part of the object overlap, the object is "in" the plot; if there is no overlap, then the object is "out" of the plot. A prism sweep results in the tally of stems based on stand basal area using a variable radius plot.

Pruning: The removal of the lower branches of crop trees to a predetermined height, usually correlated to log lengths, to produce clear, knot-free wood. Knot-free wood increases the value of the final wood products.

PSS: Planting stocking standard.

Rank: A term used in inventory labels. It describes the relative position of a layer in its progression toward merchantability. Rank 1, for example, denotes the next potentially harvestable layer of a stand. Rank is no longer used.

Reforestation: The natural or artificial restocking of an area.

Regeneration date/delay: The date by which a minimum number of healthy, well-spaced trees of both preferred and acceptable species, and the minimum number of preferred species, must be established, and afterwards maintained, until the stand is declared free growing.

Reserve: An area of forest land that, by law or by policy, is not available for harvesting. Areas of land and water set aside for ecosystem protection, outdoors and tourism values, preservation of rare species, wildlife protection, etc.

The retention following harvest of live or standing dead trees that are pole size or larger for purposes other than regeneration. Reserves can be uniformly distributed as single trees or left in small groups.

Reserve tree: A tree that is specifically reserved from harvesting and/or silviculture activities.

Reserve zone: The inner portion of a riparian management area situated adjacent to a stream, lake, or wetland. Reserve zones are established to conserve and to maintain the productivity of aquatic and riparian ecosystems.

Residual basal area: The basal area per hectare left standing after harvest.

Residuals (residual trees): Trees left standing after harvesting.

Riparian: An area of land adjacent to a stream, river, lake, or wetland that contains vegetation that, due to the presence of water, is distinctly different from the vegetation of adjacent upland areas.

Riparian management area (RMA): An area of specified width surrounding or adjacent to streams, lakes, riparian areas, and wetlands. The RMA includes, in many cases, adjacent upland areas. It extends from the top of the stream bank (bank full height), or from the edge of a riparian area or wetland, or the natural boundary of a lake, outward to the greater of: (1) the specified RMA distance, (2) the top of the inner gorge, or (3) the edge of the floodplain. Where a riparian area or wetland occurs adjacent to a stream or lake, the RMA is measured from the outer edge of the wetland.

Riparian reserve: A type of reserve adjacent to a water body.

Rotation: The planned number of years between the formation or regeneration of a tree crop or stand and its final cutting at a specified stage of maturity. Can be based on physical, biological, pathological, or economic criteria.

Rotation age: The age at which a stand is considered mature and ready for single entry harvesting under an even-aged management strategy.

RPF (registered professional forester): A person registered under the *Foresters Act* who performs or directs works, services, or undertakings requiring specialized knowledge, training, and experience in forestry.

Sanitation cutting: Improving the growth and health of young stands by removing damaged or diseased stems.

Sapling: A young tree that is larger than a seedling but smaller than a pole. Size varies by region.

Satisfactorily restocked (SR): Productive forest land that has been denuded and subsequently regenerated to the specified stocking standards in the silviculture prescription.

SBFEP: Small Business Forest Enterprise Program.

Scalping: A site preparation method that exposes favourable mineral soil in which tree seedlings can be planted.

Scar: A mark left after regrowth of damaged tissue following an injury.

Scarification: See Drag scarification.

Screefing: Removing organic material to a specified depth.

Second growth: A second forest that develops after harvest of the original mature forest.

Seedbed: In natural regeneration, the soil or forest floor on which seed falls. In nursery practice, a prepared area over which seed is sown.

Seedlot: A quantity of cones or seeds having uniformity of species, source, quality, and year of collection.

Seed orchard: An area of specially planted trees that have been selected for their superior characteristics to breed genetically improved seed.

SEMS: Silviculture Electronic Mapping System.

Seral species: A tree species (or plant) that is adapted to exist during a specific period of forest succession or seral stage.

Shade tolerance: The capacity of a tree or plant species to develop and grow in the shade of other trees or plants. Shade tolerance is one trait of the silvics of a species and independent of competition vigor.

Silviculture: The art and science of managing the establishment, growth, composition, health, and quality of forests and woodlands to meet the diverse needs and values of landowners and society on a sustainable basis.

Silviculture prescription (SP): A legally binding, site-specific plan describing the nature and extent of any timber harvesting and silviculture activities carried out on an opening. The silviculture prescription outlines the required management objectives, standards, and timelines that the owner of the opening must achieve, including reaching a free growing stand. Before the Forest Practices Code, silviculture prescriptions were known as pre-harvest silviculture prescriptions (PHSPs).

Silviculture survey: An examination of an opening for the purpose of providing information to the forest manager on how the site and the stand are progressing relative to the prescribed management objectives.

Silviculture treatment regime: A legally required, site-specific list of silviculture treatments that can reasonably be expected to produce the designated stocking levels specified in the silviculture prescription by the end of the determined free growing assessment period. This regime must be prepared and kept on file by a registered professional forester. Refer to Section 11 of the Silviculture Practices Regulation for more information. See also *Target Stocking Requirements and Silviculture Treatment Regimes* (Forest Practices Bulletin No. 28).

Site class: The measure of the relative productive capacity of a site.

Site class conversion: The method of determining site index by estimating the site class then using Table A1.1 to convert site class to site index. This method is the least accurate of site index determination methods.

Table A1.1 Site class to site index conversion

Inventory label leading species	Region	Good	Medium	Poor	Low
Broadleaf species					
Ac	Province	26	18	9	3
At	Province	27	20	12	4
Dr	Province	33	23	13	6
E, Ea, Ep	Province	27	20	12	4
B, Ba, Bg	Coastal	29	23	14	5
B, Ba, Bg	Interior	18	15	11	5
Mb	Province	33	23	13	6
Conifer species					
Bl	Province	18	15	11	5
Cw	Coastal	29	23	15	6
Cw	Interior	22	19	13	5
Fd	Coastal	32	27	18	7
Fd	Interior	20	17	12	5
H, Hm, Hw	Coastal	28	22	14	5
H, Hm, Hw	Interior	21	18	12	4
L, La, Lt, Lw	Province	20	18	10	3
Pa, Pf, Pj, Pl	Province	20	16	11	4
Pw	Province	28	22	12	4
Py	Province	17	14	10	4
S	Coastal	28	21	11	4
S	Interior	19	15	10	5
Ss	Province	28	21	11	4
Sb, Se, Sw	Province	19	15	10	5
Yc	Coastal	29	23	15	6
Yc	Interior	22	19	13	5

Site index: A measure of site growth potential for a given tree species over a fixed time period. It is the average top height of trees of a certain species at 50 years measured at breast height. The top height trees are the 100 largest DBH trees per hectare of the species being considered. The breast height age is the number of annual growth rings at 1.3 m from the point of germination.

A complete discussion on site index determination can be found in How Determine Site Index in Silviculture.

Site Plan: The most current form of a silviculture prescription used on woodlots.

Site preparation: Disturbance of an area's topsoil and ground vegetation to create conditions suitable for regeneration.

Site rehabilitation: The conversion of potentially productive land presently occupied by stands of undesirable species, or by brush, back to a condition appropriate for establishing desired coniferous species.

Site series: Subdivisions of site associations. Site series include all sites within a biogeoclimatic subzone that are capable of producing the same climax vegetation unit or plant association.

Skid trail: A roughly formed, temporary forest trail suitable for use by horses or equipment, such as skidders, in hauling trees or logs from the place of felling to a landing.

Slash: The residue left on the ground after felling, juvenile spacing, brushing, pruning, or commercial thinning that includes cut trees, uprooted stumps, branches, and broken tops.

Slope correction tables: Tables with conversions from slope distance to horizontal distance.

Snag: A standing dead tree, greater than 5 m in height, often used by birds for nesting, or by wildlife for refuge. Can be a hazard to forest workers, as it could fall unexpectedly. Also called a danger tree or a wildlife tree.

Spacing: See juvenile spacing.

sph: Stems per hectare. This term is interchangeable with trees per hectare or trees/ha.

Standards Unit (SU): An area that is managed through the uniform application of a silvicultural system, stocking standards, and soil conservation standards. These standards are used to determine if legal regeneration, free growing, and soil conservation obligations are met.

Stand density: A relative measure of the amount of stocking on a forest area. Often described in terms of stems per hectare.

Stand management prescription (SMP): A site-specific plan describing the nature and extent of the silviculture activities planned for a free growing stand of trees. SMPs facilitate the achievement of specified social, economic, and environmental objectives.

Stand tending: A variety of forest management activities carried out at different stages in the life of a stand. Treatments may include juvenile spacing, brushing, commercial thinning, fertilization, conifer release, site rehabilitation, mistletoe control, seed tree control, and pruning.

Statistical sampling: The selection of sample units from a population and the measurement and/or recording of information on these units to obtain estimates of population characteristics.

Stocking class: A numeric code representing a range of stems per hectare. Example, stocking class 1 is mature, with 76+ stems/ha of > 27.5 cm dbh; stocking class 2 is mature, with < 76 stems/ha; stocking class 0 is immature.

Stocking standards: Stocking standards detail site-specific legal requirements that are stated in silviculture prescriptions. They specify the standards required to reforest denuded areas with a healthy new crop of trees within specific time frames. Stocking standards include such information as the target and minimum number of healthy, well-spaced, preferred and acceptable trees per hectare, the conifer/brush ratio, the maximum density, the regeneration date, and the early and late free growing dates.

Stocking status: Stocking is an indication of growing space occupancy relative to a pre-established standard. Status refers to whether the site has met those standards. Stocking status is most often described as satisfactorily restocked, not satisfactorily restocked, free growing, or not free growing.

Stocking survey: A survey used to determine the stocking status of an opening by describing both the preferred and acceptable well-spaced and total trees, and to generate an inventory label for updating the forest cover map.

Stratification: The process of defining and identifying populations with similar characteristics within an opening.

Stratum: A subdivision of a forest area to be inventoried based on a group of trees with the same or similar species composition, age, and/or height class (plural = strata).

Suppressed: Trees with crowns entirely below the general level of the crown cover, and receiving little or no direct light from above or from the sides.

Survival assessment: A survey that estimates the percentage of trees living after a set period of growth after planting.

Target stocking standard (TSS): The number of well-spaced, preferred and acceptable trees per hectare that will, in normal circumstances, produce an optimum free growing crop. Target stocking standards are those standards that should be achieved through silviculture activities.

Tenure: The holding of a property. Land tenure may be broadly categorized into private lands, federal lands, and provincial Crown lands. The *Forest Act* defines a number of forestry tenures by which the cutting of timber and other user rights to provincial Crown land are assigned (e.g., forest licence).

Transplanting: Moving seedlings from one place to another.

Treatment prescription: A legal document describing the operational details required for carrying out individual silviculture activities such as site preparation and planting.

Treatment Unit (TU): An area of land upon which a silviculture activity is planned and carried out, usually within the boundary of an opening. In old PHSPs, TUs are areas managed through the uniform application of stocking standards. In newer SPs, TUs are now referred to as Standards Units (SUs).

Tree farm licence (TFL): A form of tenure agreement that allows the long-term practice of sound forest management and harvesting on Crown land or on a combination of Crown and private land, by private interests under the supervision of the MOF.

Uneven-aged: Stands with a wide range of ages and sizes.

Uniform leave tree (ULT): A type of reserve where trees are retained in an even pattern of distribution.

Vet (veteran): A living remnant of a former stand. When used in the context of inventory labels, vets must have a combined crown closure of less than 6%, and must be at least 40 years older and 10 m taller than the main stand. This term is being phased out.

Walk-through: An initial reconnaissance of an opening prior to the onset of a survey.

Well-spaced stems per hectare: The number of healthy, preferred and acceptable trees, in 1 ha that are all at least the minimum horizontal inter-tree distance from one another. The inter-tree distance is specified in the silviculture prescription.

Whorl: An arrangement of branches in a circle around a stem or tree trunk often, but not always, associated with 1 year's height growth.

Wildlife tree: A standing live or dead tree with special characteristics that provide valuable habitat for the conservation or enhancement of wildlife. Characteristics include large diameter and height for the site, current use by wildlife, a declining or dead condition, value as a species, valuable location, and relative scarcity.

Wildlife tree patch (WTP): An area specifically identified for the retention and recruitment of suitable wildlife trees. It can contain a single wildlife tree or many. A wildlife tree patch is synonymous with a group reserve.

Windrowing: The concentration of slash, branches, and debris into rows to clear the ground for regeneration. Windrows are often burned.

Wound: An injury that removes a portion of the bark and cambium from the tree, but does not penetrate into the sapwood. Wounds often serve as entry points for wood decay fungi.

Xeric: The driest site series within each unit of the biogeoclimatic system. Xeric is always referred to as an 02 site series.

Zonal: Within the biogeoclimatic classification system, zonal sites are those that are the most common or average within a single zone. It may also be referred to as mesic.

Terrestrial Information Branch (Ministry of Sustainable Resource Management) maintains an additional Glossary of Terms.

Appendix 2. Determining area of dispersed strata

For dispersed strata, it is necessary to determine the area represented by each stratum found on an opening. Although the area represented by each stratum may be estimated, a more quantitative measurement may be desired. In this event, two methods should be considered: line intersect and high intensity point sampling.

Line Intersect

One method of determining the area represented by each stratum, in dispersed strata, is the line intersect survey. The amount of strip line that crosses each stratum is used to calculate the proportion of the opening that is represented by that stratum. The amount of strip line per hectare required to be sampled on an opening depends on the characteristics of the stratum. An opening with two evenly distributed strata requires less strip line than an opening with more strata or less evenly distributed strata.

A complete discussion of the topic of line intersect surveys is found in the Special Surveys section of the *Silviculture Surveys Guidebook*.

High Intensity Point Sampling

Another method of determining the area represented by each stratum, in dispersed strata, is the high intensity point sampling survey. The intent of this survey is to tally large quantities of very simple point samples. The data are used to estimate the area of each stratum. This sampling method provides the same results as the line intersect survey, but uses a less onerous field procedure.

These procedures have not been statistically analyzed to determine the number of point samples required to calculate the precision of the survey. Initial estimates suggest that 100-point samples are a reasonable preliminary sampling intensity.

The following steps describe the point sampling process (Figure A2.1):

1. Describe each stratum or forest type.
2. Establish the desired quantity of point samples in a systematic method.
3. At each point sample, mark a ✓ or an × to indicate which stratum or forest type the sample is within.

Plot	Stratum/ Forest type A	Stratum/ Forest type B	Stratum/ Forest type C	Stratum/ Forest type D	Comments
	SR & FG	SR but not FG	NSR	NP	
1	✓				
2	✓				
3		✓			alder
4	✓				
5	✓				
6			✓		plantable
7	✓				
8			✓		slash, but plantable
9				✓	rock, no stumps
10		✓			alder
11	✓				
12	✓				

No. of point samples				
100	85	10	4	1

Stratum A	Stratum B	Stratum C	Forest type D
SR & FG	SR but not FG	NSR	NP
85%	10%	4%	1%

Figure A2.1. High Intensity Point Sample Plot card.

Appendix 3. List of references and hyperlinks

The following references are useful to silviculture surveyors in British Columbia.

Acts

Ministry of Forests Act
http://www.for.gov.bc.ca/tasb/legsregs/minfor/minfact/mofa.htm

Forest Act
http://www.for.gov.bc.ca/tasb/legsregs/forest/foract/contfa.htm

Forest Practices Code of British Columbia Act
http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcact/contfpc.htm

Regulations

Operational Planning Regulation
http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcaregs/oplanreg/opr.htm

Silviculture Practices Regulation
http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcaregs/silvprac/spr.htm

Administrative Remedies Regulation
http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcaregs/adminrem/adminrem.htm

Guidebooks

Silviculture Surveys Guidebook
http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/silsurv/silsutoc.htm

Establishment to Free Growing Guidebook - Cariboo Forest Region
http://www.for.gov.bc.ca/tasb/legsregs/fpc/FPCGUIDE/FREE/EFG-Car-web.pdf

Establishment to Free Growing Guidebook - Kamloops Forest Region
http://www.for.gov.bc.ca/TASB/LEGSREGS/FPC/FPCGUIDE/free/EFG-Kam-web.pdf

Establishment to Free Growing Guidebook - Nelson Forest Region
http://www.for.gov.bc.ca/TASB/LEGSREGS/FPC/FPCGUIDE/free/EFG-Nel-web.pdf

Establishment to Free Growing Guidebook - Prince George Forest Region
http://www.for.gov.bc.ca/TASB/LEGSREGS/FPC/FPCGUIDE/free/EFG-PG-web.pdf

Establishment to Free Growing Guidebook - Prince Rupert Forest Region
http://www.for.gov.bc.ca/TASB/LEGSREGS/FPC/FPCGUIDE/free/EFG-PR-web.pdf

Establishment to Free Growing Guidebook - Vancouver Forest Region
http://www.for.gov.bc.ca/TASB/LEGSREGS/FPC/FPCGUIDE/free/EFG-Van-web.pdf

Soil Conservation Guidebook
http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/soil/soil-toc.htm

Soil Conservation Surveys Guidebook
http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/SOILSURV/soil-toc.htm

Soil Rehabilitation Guidebook
http://www.for.gov.bc.ca/tasb/legsregs/fpc/FPCGUIDE/soilreha/REHABTOC.HTM

Generic Forest Health Surveys Guidebook
http://www.for.gov.bc.ca/TASB/LEGSREGS/FPC/FPCGUIDE/health/Httoc.htm

Bark Beetle Management Guidebook
http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/beetle/betletoc.htm

Defoliator Management Guidebook
http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/defoliat/defoltoc.htm

Dwarf Mistletoe Management Guidebook
http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/dwarf/dwarftoc.htm

Terminal Weevils Guidebook
http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/weevil/we-toc.htm

Pine Stem Rust Management Guidebook
http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/PINESTEM/PINE-TOC.HTM

Root Disease Management Guidebook
http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/root/roottoc.htm

Tree Wounding and Decay Guidebook
http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/Decay/Tw-toc.htm

Green-up Guidebook
http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/greenup/index.htm

Field Cards

FS 657 Silviculture Survey Card
http://www.for.gov.bc.ca/isb/forms/lib/fs657.pdf

FS 658 Silviculture Survey Plot Card
http://www.for.gov.bc.ca/isb/forms/lib/fs658.pdf

FS 659 Silviculture Survey Summary Card
http://www.for.gov.bc.ca/isb/forms/lib/fs659.pdf

FS 660 Silviculture Survey Reference Card
http://www.for.gov.bc.ca/isb/forms/lib/FS660.pdf

FS 747 Damage Agent and Condition Codes Card
http://www.for.gov.bc.ca/isb/forms/lib/FS747.pdf

FS 1138A Calculation Card for Silviculture Survey Confidence Limits
http://www.for.gov.bc.ca/isb/forms/lib/FS1138A.pdf

FS 1138B Steps to Calculate Confidence Limits for Silviculture Surveys
http://www.for.gov.bc.ca/isb/forms/lib/FS1138B.pdf

Training Materials

How to Determine Site Index in Silviculture
http://www.for.gov.bc.ca/hfp/pubs/sicourse/

Forest Health for Silviculture Surveys
The materials are complete but the Web site is currently being developed.

Fundamentals of Natural Lodgepole Pine Regeneration and Drag Scarification
http://www.for.gov.bc.ca/hfp/pubs/silvsurveys/NatPlregen.pdf

Juvenile Spacing Quality Inspection
http://www.for.gov.bc.ca/isb/forms/lib/fs251.pdf

Planting Quality Inspection: Completing the FS 704
http://www.for.gov.bc.ca/isb/forms/lib/FS704A.pdf

Guidelines for Developing Stand Density Management Regimes
http://www.for.gov.bc.ca/hfp/pubs/stand%5Fdensity%5Fmgt/index.htm

Policies and Other Documents

Backlog Management Policy
http://www.for.gov.bc.ca/tasb/manuals/policy/resmngmt/rm2-22.htm

Changes to Maximum Density Requirements in Silviculture Practices Regulation Section 13
http://www.for.gov.bc.ca/hfp/pubs/stand%5Fdensity%5Fmgt/maxchng2.htm

Enforceability of Free Growing Obligations on Pre-Code Prescriptions – Forest Practices Bulletin No. 27
http://www.technapro.com/Bulletins/Guide27.pdf

Target Stocking Requirements and Silviculture Treatment Regimes – Forest Practices Bulletin No. 28
http://www.technapro.com/Bulletins/Guide28.pdf

Evaluation of Forest Health in Free Growing Assessments – Forest Practices Bulletin No. 34
http://www.technapro.com/Bulletins/Guide34.pdf

Free Growing Declaration and Acknowledgement – Forest Practices Bulletin No. 39
http://www.technapro.com/Bulletins/Guide39.pdf

Submission of Free Growing Reports by Standards Unit – Forest Practices Bulletin No. 40
http://www.technapro.com/Bulletins/Guide40.pdf

Resource Inventory Branch Web Site
http://www.for.gov.bc.ca/resinv/homepage.htm

Silviculture Surveys Accreditation Program Brochure
http://www.for.gov.bc.ca/hfp/forsite/training/silv_survey_accred/silvicultures.html

Vegetation Resources Inventory Ground Sampling Procedures
http://srmwww.gov.bc.ca/risc/PUBS/TEVEG/index.htm

Relational Data Dictionary (RDD) 2.0a
http://www.for.gov.bc.ca/resinv/reports/rdd/RDD.HTM

Miscellaneous Publications

Many of the following publications can be ordered from Crown Publications.

Autecology of Common Plants in British Columbia: A Literature Review. 1990. Haeussler, S., D. Coates, and J. Mather. FRDA Report 158. ISSN 0835-0752.

Controlling Weeds Using Biological Methods
Full Graphics
http://www.for.gov.bc.ca/hfp/pubs/interest/noxious/noxtoc.htm
Text Only
http://www.for.gov.bc.ca/hfp/pubs/interest/noxious/noxtext.htm

Describing Ecosystems in the Field. 1990. Luttmerding, H., D. Demarchi, E.C. Lea, D.V. Meidinger, and T. Vold (editors and compilers). 2nd ed. B.C. Ministry of Environment, Lands and Parks. MOE Manual 11, Victoria, B.C.

Biogeoclimatic Zones of British Columbia
http://www.for.gov.bc.ca/research/becweb/becinfo/index.htm

Ecosystems of British Columbia. 1991. B.C. Ministry of Forests. Special Report Series 6. ISSN 0843-6452.

The Effects of the Silviculture Survey Parameters on the Free Growing Decision Probabilities and Projected Volume at Rotation. 2002. Bergerud, W.A. B.C. Ministry of Forests, Forest Science Program. Land Management Handbook No. 50. ISBN 0-7726-4723-2.

Effectiveness of Forest Vegetation Control Methods in British Columbia. 1996. Biring, B. S. P.G. Comeau and J.O. Boateng. B.C. Ministry of Forets FRDA Handbook 011 ISSN 0835-1929; 011

Operational Summaries for Vegetation Management
Cottonwood Complex, 2002, Province of B.C., ISBN 0-7726-4720-8

Dry Alder Complex, 1997, Province of B.C., ISBN 0-7726-3161-1
http://www.for.gov.bc.ca/hfp/pubs/vegmngt/dryalder.pdf

Ericaeous Shrub Complex, 1997, Province of B.C., ISBN 0-7726-3162-X
http://www.for.gov.bc.ca/hfp/pubs/vegmngt/ericaceo.pdf

Fern Complex, 2002, Province of B.C.,ISBN 0-7726-4718-6

Fireweed Complex, 1997, Province of B.C., ISBN 0-7726-3163-8
http://www.for.gov.bc.ca/hfp/pubs/vegmngt/fireweed.pdf

Mixedshrub Complex, 1997, Province of B.C., ISBN 0-7726-3164-6
http://www.for.gov.bc.ca/hfp/pubs/vegmngt/mixshrub.pdf

Pinegrass Complex, 1997, Province of B.C., ISBN 0-7726-3165-4
http://www.for.gov.bc.ca/hfp/pubs/vegmngt/pinegras.pdf

Red Alder-Salmonberry Complex, 2002, Province of B.C., ISBN 0-7726-4721-6

Reedgrass Complex, 2000, Province of B.C., ISBN 0-7726-4365-2
http://www.for.gov.bc.ca/hfp/pubs/vegmngt/reedgrass.pdf

Salal Complex, 2002, Province of B.C., ISBN 0-7726-4719-4

Wet alder Complex, 1997, Province of B.C., ISBN 0-7726-3167-0
http://www.for.gov.bc.ca/hfp/pubs/vegmngt/wetalder.pdf

Willow Complex 1997, Province of B.C., ISBN 0-7726-3116-2
http://www.for.gov.bc.ca/hfp/pubs/vegmngt/willow.pdf

Field Guide to Forest Damage in British Columbia. Joint Publication No. 17. Henigman, J., T. Ebata, E. Allen, J. Holt and A. Pollard; Victoria, 1999. ISBN 0-7726-3866-7.

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A Field Guide for Site Identification and Interpretation for the Nelson Forest Region. 1992. B.C. Ministry of Forests. ISSN 0229-1662.

A Field Guide for Site Identification and Interpretation for the Prince George Forest Region. B.C. Ministry of Forests. ISSN 0229-1622.

LMH 15 (Rocky Mountain Trench) – January 1988

LMH 21 (Northwest Portion of the Prince George Forest Region) – February 1990
http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh21.htm

LMH 22 (Northeast Portion of the Prince George Forest Region) – February 1990
http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh22.htm

LMH 24 (Southwest Portion of the Prince George Forest Region) – January 1993
http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh24.htm

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http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh29.htm

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A Field Guide for Site Identification and Interpretation for the Vancouver Forest Region. 1994. B.C. Ministry of Forests. Land Management Handbook No. 28. ISSN 0229-1622.

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http://srmwww.gov.bc.ca/risc/pubs/teecolo/fmdte/deif.htm

Funding Source Codes
http://www.for.gov.bc.ca/isb/isis/user%5Fguide/append%5Fc/a%5Fc%5F07.htm

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http://www.for.gov.bc.ca/isb/index.htm

Land Management Handbooks
http://www.for.gov.bc.ca/hfd/pubs/Lmh.htm

Broom – Putting It in Its Place
http://www.for.gov.bc.ca/hfp/pubs/interest/broom/broom.htm

Gorse – The Spiny Competitor
http://www.for.gov.bc.ca/hfp/pubs/interest/gorse/gorse.htm

Managing Vegetation in Provincial Forests
http://www.for.gov.bc.ca/hfp/pubs/interest/vegman/vegman.htm

Managing Vegetation with Sheep
http://www.for.gov.bc.ca/hfp/pubs/interest/vegman/sheepman.htm

Plant Indicator Guide for Northern British Columbia. 1999. Beaudry, L., R. Coupé, C. Delong, and J. Pojar. Land Management Handbook No. 46.

Provincial Seedling Stock Type Selection and Ordering Guidelines
B.C. Ministry of Forests, Forestry Division Services. Contact Publications Distribution Coordinator at 250-356-2093.

Resource Inventory Branch FCAPS – Forest Cover Attribute Processing
http://www.for.gov.bc.ca/resinv/standard/volume5/Chap1/chap1.htm

Resource Inventory Branch, Glossary of Terms
http://www.for.gov.bc.ca/resinv/standard/volume5/app12-15/app12-15-02.htm

Silviculture Prescriptions Field Methods Book

Interpretive Guide for Data Collection, Stratification, and Sensitivity Evaluation for Silviculture Prescriptions. Interim draft. May 1997. B.C. Ministry of Forests, Forest Practices Branch.
http://www.for.gov.bc.ca/hfd/pubs/docs/sil/sil411.htm

Silviculture Prescriptions Field Methods Book
http://www.for.gov.bc.ca/hfd/pubs/docs/sil/sil411/A4110004.htm#E9E5

Site Index Estimates by Site Series for Coniferous Tree Species in British Columbia. 1997. B.C. Ministry of Forests. ISBN 0-7726-3401-7.

Silviculture Note No. 26 – Sheep Grazing in Forestry
http://www.for.gov.bc.ca/hfp/pubs/silviculture_notes/sn26.pdf

Silviculture Note No. 25 – Boreal Plant Community Diversity 10 Years after Treatment; A Report Summary
http://www.for.gov.bc.ca/hfp/pubs/silviculture_notes/sn25.pdf

Towards a Taxonomic Classification of Humus Forms. 1990. Luttmerding, H.A., D.A. Demarchi, E.C. Lea, D. Meidinger, and T. Vold. B.C. Ministry of Forests, Burnaby, B.C. For. Sci. Monogr. No. 29. 49 p.

Tree Doctor (forest health database)
http://www.for.gov.bc.ca/hfp/training.htm

Appendix 4. Using a prism

The prism is a tool used to estimate the amount of basal area currently present on an opening. Basal area is a measure of site occupancy. It is expressed in terms of square metres per hectare (m^2/ha). While it is possible to accurately determine basal area using a prism, it is often necessary only to determine a reasonable estimate of the basal area for multi-storey surveys. The procedures described in this appendix are recommended where the silviculture prescription does not specify a minimum basal area requirement in the stocking standards. Where a minimum basal area is specified in the silviculture prescription, the procedures for basal area determination described in the *Ministry of Forests Cruising Manual* should be applied.

It is essential that all prisms used on a single stratum be of the same basal area factor (BAF). Using prisms of different sizes on the same strata would have the same effect as using multiple plot radii on a single stratum. All data collected for a single stratum must be gathered using a single BAF.

The surveyor holds the prism over plot centre and looks at a tree across the upper edge of the prism. The surveyor should see the tree simultaneously above the prism in its natural position, and also through the prism. Because a ray of light is bent upon passing through the prism, the tree image seen through the prism will be horizontally displaced.

If the displacement is greater than the diameter of the tree, the tree is considered "out" and therefore not counted. If the displacement is less than or equal to the diameter of the tree, the tree is "in" and is therefore counted (Figure A4.1).

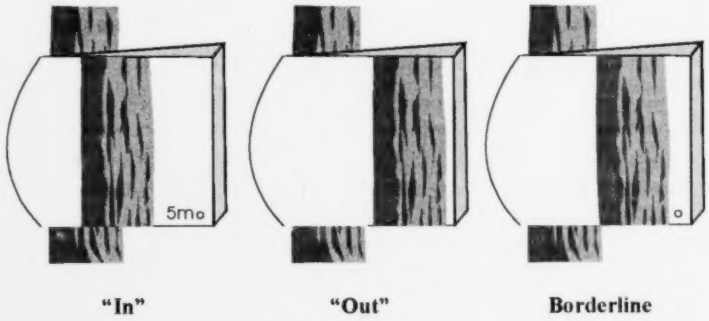


Figure A4.1. Using a prism to determine if a tree is "in," "out," or "borderline."

Borderline Trees

The precision required for determining basal area depends on whether the silviculture prescription for the stratum contains a minimum basal area.

Where a borderline tree is identified:

- Using the prism, confirm that the tree is in fact borderline.
- Decide arbitrarily to record the tree "in" or "out." The next time a borderline tree is identified in the stratum, record it opposite to the first borderline tree. In other words, double check your measurement using the prism, then simply alternate the borderline calls.

No Minimum Basal Area Prescribed in Silviculture Prescription

The collection of basal area information is not mandatory, but is highly recommended. The resulting data can be valuable descriptive characteristics of stand structure. Where it is not required as part of the stocking standards for an opening, the desired level of accuracy for basal area data is relatively low. Field procedures can therefore be streamlined to keep costs in line while still gathering useful data.

Silviculture Prescription with Minimum Basal Area

The status of borderline trees is more important on areas where a minimum basal area is specified in the silviculture prescription. Alternating is not sufficiently accurate. We must use the more precise techniques used in cruising. This requires the following steps (or use Table A4.1):

1. Measure the diameter at breast height of the borderline tree.
2. Identify the correct plot radius factor (PRF) for the prism being used. The plot radius factor (PRF) is determined using the following formula:

$$\mathbf{PRF = 0.5/BAF}$$

The BAF is the prism basal area factor in m^2/ha.

Table A4.1. Plot radius factors and relaskop values for selected basal area factors

Basal area factor (BAF)	Plot radius factor (PRF)	Relaskop value	Basal area factor (BAF)	Plot radius factor (PRF)	Relaskop value
1	0.5000		12.25	0.1429	
2	0.3536		13	0.1387	
3	0.2887		14	0.1336	
4	0.2500		15	0.1291	
5	0.2235	5.06	16	0.1250	16.00
6	0.2041		18	0.1179	
6.25	0.2000		20	0.1118	20.25
7	0.1890	6.25	20.25	0.1111	
8	0.1768		24	0.1021	
9	0.1667	9.00	25	–	25.00
10	0.1581		30.25	0.0909	
11	0.1508		32	0.0884	
12	0.1443	12.25	64	0.0625	
			128	0.0442	

3. Multiply the DBH by the PRF to determine the maximum distance the tree can be from the plot centre.
4. Measure the distance from the "estimated centre" (half of the diameter of the tree measured at dbh) of the tree to the plot centre.
5. If this measured tree is less than or equal to maximum distance away from the plot centre, the tree is "in." If it is further away than maximum distance, this tree is "out."

For example:

BAF 5 = PRF 0.2235

28.0 cm dbh × 0.2235 = 6.26 m

If this 28.0-cm tree is less than or equal to 6.26 m from the plot centre, the tree is "in." If it is farther away than 6.26 m, the tree is "out."

The subject is discussed in further depth in the *Vegetation Resource Inventory – Ground Sampling Procedures*.

Appendix 5. Magnetic declination and annual change

Magnetic declination is the adjustment for the difference between magnetic north and grid north. Correct calibration of the compass used by surveyors is one important factor to ensure the desired accuracies are met. Surveyors should ensure that the proper declination has been set on their compasses before conducting a survey.

The amount of adjustment varies with current position and over the passing of time. Appendix E of the *Vegetation Resource Inventory Ground Sampling Procedures*, *Magnetic Declination and Annual Change* provides the adjustment factors. In addition, the following Web site provides an automated declination calculator where latitude and longitude are known: http://www.geolab.nrcan.gc.ca/geomag/e_cgrf.html.

Appendix 6. Forest cover map legend

1. FOREST LAND
A. FOREST LAND (FORESTED)
SPECIES COMPOSITION
Species are listed in their order of predominance. Major Species are listed first, followed by minor species in brackets.
SPECIES SYMBOLS
The standard symbols for some species are abbreviated, e.g. Fd is shown as F, Cw is shown as C.
F - Douglas fir
C - Western red cedar
H - Hemlock
B - Balsam (True fir)
S - Spruce
Sb - Black spruce
Yc - Yellow cedar
Pw - Western white pine
Pb - Whitebark pine
Pl - Limber pine
Pl - Lodgepole pine
Pj - Jack pine
Py - Yellow pine
L - Larch
Ac - Cottonwood
D - Red alder
Mb - Broadleaf maple
E - Birch
At - Aspen
AGE CLASS
CODE | LIMITS (years)
1 | 1 - 20
2 | 21 - 40
3 | 41 - 60
4 | 61 - 80
5 | 81 - 100
6 | 101 - 120
7 | 121 - 140
8 | 141 - 250
9 | 251 +
HEIGHT CLASS
CODE | LIMITS (metres)
1 | 0.1 - 10.4
2 | 10.5 - 19.4
3 | 19.5 - 28.4
4 | 28.5 - 37.4
5 | 37.5 - 46.4
6 | 46.5 - 55.4
7 | 55.5 - 64.4
8 | 64.5 +
SITE INDEX
All SI values shown to the nearest meter, referenced at 50 years Breast Height Age.
SI is based on the age and height of the leading species. When an accurate SI cannot be obtained from age and height, Estimated SI is shown after, or replaces the SI.
ESTIMATED SITE INDEX
SI is estimated when suitable SI trees are not present.
e.g., NSR, young stands (<30 years), stands released following suppression. It is denoted by a slash which always precedes it.
Associated fields in the data base are Inventory Type Group and SI Estimated source code.
STOCKING CLASS CODES
CODE | APPLIES TO | LIMITS: No. trees/hectare, diameter - breast height (dbh)
0 | all immature | N.A.
1 | all mature | ≥716/ha, 27.5 cm+ dbh
2 | all mature | <716/ha, 27.5 cm+ dbh
P | all mature stands disturbed | stands disturbed 26-75% by area or volume
3 to 4 subdivision | mature, with leading species P1 | ≥311/ha, 17.5 cm+ dbh, and ≥50% of stems 7.5 cm+ dbh are ≥12.5 cm dbh
3 to 4 subdivision | mature, with leading species P1 | <311/ha, 17.5 cm+ dbh, or ≥311/ha, 17.5 cm+ dbh, and <50% of stems 7.5 cm+ dbh are ≥12.5 cm dbh
CROWN CLOSURE CLASS
CODE | LIMITS (percentage)
0 | 0 - 5
1 | 6 - 15
2 | 16 - 25
3 | 26 - 35
4 | 36 - 45
5 | 46 - 55
6 | 56 - 65
7 | 66 - 75
8 | 76 - 85
9 | 86 - 95
10 | 96 - 100
HISTORY SYMBOLS
CLASS SYMBOL | CODE | HISTORY
Disturbance | B | Wildfire
| BC | Escaped Burn
| BP | Ground Burn
| BW | Range Burn
| D | Wildlife Burn
| F | Disease
| I | Flooding
| K | Insect
| L | Fume Kill
| LA | Logging
| S | Logged(10% increments)
| W | Site renutrition
| | Slide
| | Windthrow
Regeneration | | Artifical Regeneration
| | with year(s) of planting
Stand Tending | F | Fertilization
| H | Thick and squirt
| J | Juvenile spacing
| M | Manual control
| P | Pruning
| R | Control release
| S | Selective release
| T | Commercial thinning
| W | Brushing and weeding
Site Preparation | B | Broadcast burn
| C | Chemical
| G | Grass seeded
| H | Hand preparation
| PB | Range management burn
| S | Spot burn
| M | Mechanical
| MS | Mechanical and spot burn
| W | Windrow
MULTI-LAYER
L - Multi-layered stand (a separate description of each layer is available in the data base, i.e., 1, 2)
V - Veteran component
S - A separate silviculture description is available in the data base
EXAMPLE OF A FOREST COVER LABEL
O12 - SILVICULTURE SYMBOL AND OPENING NUMBER
123 - POLYGON NUMBER
Fs2w - E.S.A. CATEGORY
L - MULTI-LAYER
A - QUALIFIER
CF(SH) - SPECIES COMPOSITION
2101-20 - AGE CLASS CODE
879-81 - HEIGHT CLASS CODE
W17@L13 - STOCKING CLASS CODE
P80-81 - CROWN CLOSURE CLASS CODE
1 - SITE INDEX
20
879-81
W17@L13
P80-81
HISTORY RECORD OPENING NUMBER
O12 - opening number valid for BCGS mapsheet
⊗12 - opening number valid for adjacent BCGS mapsheet
⊙12 - opening number valid for NTS mapsheet
blank - opening number has not been assigned

ENVIRONMENTALLY SENSITIVE AREA (E.S.A.) CATEGORIES

E.S.A. CLASS	E.S.A. CATEGORY	E.S.A. DESCRIPTION
High	*Es*	Extremely fragile or unstable soils
	Ep	Severe regeneration problems caused by geoclimatic factors
	Ea	Severe snow chute and avalanche problems
	Er	Exceptionally high recreational values
	Ew	Of critical importance to wildlife (with or without species)
	Eh	Very high water values and extreme sensitivity to harvesting
Moderate	*E2s*	Significantly fragile or unstable soils but less than those for *Es*
	E2p	Severe regeneration problems caused by biotic factors
	E2r	High recreational values but less than those for *Er*
	E2w *	High value for wildlife but less than that for *Ew* (with or without species)
	E2h	Very high water values and high sensitivity but less sensitivity than *Eh*
	Ec	Specific limitations (forest regeneration, snow avalanche areas, water, and operability) - used from 1973 to 1975 inclusive
Nil		Management practices on these lands are subject only to operational constraints consistent with the policies of the Forest Region.

* Important areas for grizzly bears along salmon-producing streams are identified by (*E2wb*)

QUALIFIERS { */A* - Complex stand (all-aged, uneven-aged) / */I* - Inoperable

FISHERIES' CONSTRAINTS

SYMBOL	STREAM VALUE TO FISH AND STREAM SENSITIVITY TO HARVESTING
▲	Nil
■	Low
●	Moderate
◆	High

NOTE: Absence of Fisheries Symbol indicates information is not available.

B. FOREST LAND (NON-FORESTED)

NSR -Not satisfactorily restocked (with or without species)
NCBr -Non-commercial brush (with or without non-commercial species)
NC -Non-commercial (with species)

C. FOREST LAND (NON-PRODUCTIVE)

A plus Forest description
NP plus Forest description

NCBr GENUS SYMBOLS

D -Alder (Mountain, Green, Sitka)
E -Birch (Water)
W -Willow
G -Dogwood
M -Maple (Vine, Rocky Mountain)
R -Arbutus
K -Cascara
V -Cherry
J -Juniper
Q -Garry Oak
T -Western Yew

II. NON-FOREST LAND

A -Alpine
R -Rock
NP / *OB* -Non-productive burn (NPBu)
NPBr -Non-productive brush
NP -Miscellaneous non-productive
S -Swamp
C -Cultivated, cleared
U -Urban
OR -Open Range
M -Wild Hay Meadow

Note: Other categories of non-forest land are written in full, e.g. Claybank, Hayfield, Gravel Bar.

III. DATA SOURCES

5(68) -Temporary ground sample, number (year), pre-1979
7(79)G -Permanent growth sample, number (year), pre-1980 and 1989+
9(89)T -Permanent Silviculturally treated growth sample, 1989+
8(75)N -Volume and/or decay sample, pre-1979 and 1988+

18(79) -Phase 1-70 mm sample
6(82) -Phase 2-temporary ground sample, 1980-1988
7(80) -Phase 3-Growth sample, 1980-1985
8(79) -Phase 3-Decay sample, 1979-1987
9(86) -Phase 3-Growth sample, 1986-1988
5(88) -Phase 3-Silviculturally treated growth sample, 1986-1988

A multi-phase sample is shown by combining any of the above bar symbols:
5(87) -Phase 1, Phase 2, Phase 3, Growth and Decay sample

7(80)I -Intensive forestry installation
5(65)R -Rectangular growth sample
EP 703(72) -Experimental Plot installation - Research

X 71801 -Air call
XG 1568 -Ground observation w/measurements (pre-1979)
XGO 18193 -Ground observation w/measurements (1979+)
XG 284183 -Ground call with measurements
XE 2-9777 -E.S.A. air call
XGE 50176 -E.S.A. ground call
XGR 110853 -Regeneration survey ground call
XGB 7853 -Ecological research ground sample
XGC 2853 -Valuation cruise plots
XGF 16180 -Range ground call

XL 51-035(74) -70 mm photography (pre-1979)
L66-261(79) -70 mm photography (1979+)

IV. MAP LABEL DESCRIPTIONS

A separate forest cover attribute file is available for each mapsheet which shows individual polygon details. The history attributes show the year and type of activity associated with that polygon. Forest cover information is updated to the year shown in the map title block and matching attribute file.

EXAMPLES OF FOREST AND NON-FOREST MAP LABELS

1) 10 / FH(C) / 9416-19
-Polygon 10 is a stand with F (Douglas Fir) and H (Hemlock) as the major species and C (Western Red Cedar) as the minor species. The stand is age class 9 (251+ yrs), height class 4 (28.5-37.4 m) stocking class L, crown closure code 6 (estimated area occupied by the canopy through vertical projection is 56-65%), and SI 19 metres.

2) 21 / A-H / 9222
-An alpine forest stand with H (Hemlock) as the only species. The stand is age class 9 (251+ yrs), height class 2 (10.5-19.4 m), stocking class 2, and crown closure code 2. Note that SI is not shown for all classes of non-productive forest types.

3) 8 / NCBr / W4-715
-A non-commercial species of W (Willow) with a crown closure code 4, growing on a productive site, estimated SI 15 metres.

4) 7Es13 / NSR-D / 1102-120 / GL72
-A not satisfactorily restocked stand by Silviculture Branch standards, but with a forest cover of Red Alder, and an ESA description of extremely fragile or unstable soils. The stand is age class 1 (3-20 yrs), height class 1 (0-10.4 m) and has an estimated SI of 20. The polygon was logged in 1972.

5) 62 / NSR-130 / GL78
-A not satisfactorily restocked area on a productive site (estimated SI 30 metres). See attribute file for SI reference species. The polygon was logged in 1978.

6) 48 / NP / GL871
-A non-productive site burned in 1971.

7) 8E2W/L / Fd / 8.3R3-13 / GL6062
-A multi-layered stand (L) with an environmentally sensitive area classification of E2w (wildlife, moderate constraint). The most important layer is described as F (Douglas Fir) and Py (Yellow Pine). The stand is age class 8 (141-250 yrs), height class 3 (19.5-28.4 m), stocking class R (residual), crown closure class 3 (26-35%), SI 13 meters and was selectively logged 60% in 1962.

8) 16 / B / 31046/13 / GL6072
-A released stand of B (Balsam), age class 3 (41-60 yrs), height class 1 (0-10.4 m), estimated SI, crown closure class 4 (36-45%), SI 6 metres (based on age and height) followed by estimated SI 13 metres, and selectively logged 60% in 1972. The estimated SI expresses the current rate of growth for a suppressed stand released after logging.

V. CARTOGRAPHIC SYMBOLS

- Timber Supply Area boundary
- Timber Supply Block boundary
- P.S.Y.U. boundary
- Forest Region boundary
- Forest District boundary
- Inventory Region boundary
- Inventory Compartment boundary
- Standard Forest Cover type line
- Opening boundary ISIS/MLSIS
- International boundary
- Interprovincial boundary
- Provincial Forest boundary
- Land District boundary
- Township boundary
- Municipal boundary
- Surveyed Lot
- Park/Reserve/Unsurveyed Lot

o^{3}BC 85116o^{4} -Flight line, photo centres

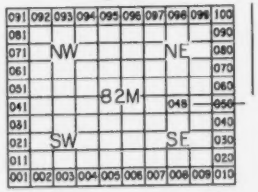
- Main road
- Secondary road
- Other: e.g. logging, industrial, etc.
- Trail
- Railroad
- Flume, ditch
- Pipe line
- Power line

FOREST COVER LINEWORK CHART

Accuracy	Forest Cover	ISIS	MLSIS
Standard			
20m			
40m			
60m			

- FS -Forest Service office
- PT -Plus Tree
- -Slide
- -Log Landing
- X -Mine
- -Lookout
- -Dam
- P.O. -Post office

BRITISH COLUMBIA GEOGRAPHIC SYSTEM
Derived from a breakdown of the N.T.S. 1:250 000 sheet
e.g. 82M



WHEN ORDERING MAPS, SHOW
Index no., Alphabet letter, Sheet no. 1:20 000, 1:10 000
e.g. 82 M .048 4

82M.048 (1:20 000)

82M.048.4 (1:10 000)

Maps may be purchased from:
Clover Point Cartographics Ltd.
152 Dallas Road, Victoria, B.C. V8V 1A3
Ph: (250) 384-3537
Toll Free: 1-888-457-2724
Website: www.cloverpoint.com
(Make cheques payable to Clover Point Cartographics.)

Appendix 7. Table of age corrections for boring height

The following reference table is provided to correct the counted age. Bore the sample tree at 1.3 m above the ground and count the number of rings. This number equals the dbh age. On Table A7.1, locate the row corresponding to the species of the sample tree. Locate the corresponding site index for the strata in which this sample tree is located.

Follow up this column to find the number of years to be added to the dbh age.

Fdi: site index of 25 = 8 years to add
dbh age + age at 1.3 m = total age

Table A7.1. Boring height age correction

Age at 1.3 metres (add this number of years to the dbh age to determine total age)												
	14	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**
Interior												
Species												
Pli	5	6	7	8	9–10	11–14	15–22	≤23				
Fdi				14–15	16–18	19–22	23–28	≥29				
Cw			5–10	11–16	17–22	23–28	29–35	≥36				
Bl			17	18–19	20–21	22–23	24–26	27–28	29–31	≥32		
Hw						≤6	7–13	14–20	21–27	28–34	≥35	
Sw			14–15	16–17	18–20	21–25	26–33	≥34				
Py	5	6	7	8	9–10	11–14	15–22	≥23				
Pw			14–15	16–17	18–20	21–25	26–33	≥34				
Lw					13–14	15–16	17–21	22–27	≥28			
At						5	6	7	8–9	10–12	13–17	≥18
Ep						5	6	7	8–9	10–12	13–17	≥18
Coastal												
Species												
Ba	≤12	13–14	15–17	18–19	20–21	22–24	25–26	27–29	30–31	≥32		
Fdc				≤16	17–22	23–28	29–35	36–41	42–47	≥48		
Act	2 years all sites											
Dr												
Cw				≤16	17–22	23–28	29–35	36–41	42–47	≥48		
Hw								≤20	21–27	28–34	35–42	≥43

Appendix 8. Ministry of Forests field cards and forms

FS No.	Form name	Format	Paper supply	Business area	Version	OPR
1138A	CALCUL.CARD/SILVI.SUR.CONFID	PDF	OPC	Forest Practices	1997/11/17	HFP
1138B	STEPS TO CALCULATE CONFIDENCE LIMITS FOR SILVICULTURE SURVEYS	PDF	OPC	Forest Practices	1997/11/17	HFP
209	MANUAL BRUSHING INSPECTION REPORT	PDF	OPC	Forest Practices	1997/11/16	HFP
251	JUVENILE SPACING QUALITY INSPECTION – DRAFT, 1.7MB	PDF		Forest Practices	2001/08/30	HFP
415A	GROWTH INTERCEPT TABLE – LODGEPOLE PINE-INTERIOR	PDF	HFP	Forest Practices	1997/02/01	HFP
415B	GROWTH INTERCEPT TABLE – INTERIOR SPRUCE-INTERIOR	PDF	HFP	Forest Practices	1995/06/01	HFP
415C	GROWTH INTERCEPT TABLE – WESTERN HEMLOCK-COASTAL	PDF	HFP	Forest Practices	1995/06/01	HFP
415D	GROWTH INTERCEPT TABLE – SITKA SPRUCE-COASTAL	PDF		Forest Practices	1995/11/01	HFP
415E	GROWTH INTERCEPT TABLE – DOUGLAS-FIR-COASTAL	PDF	HFP	Forest Practices	1996/05/01	HFP
415F	GROWTH INTERCEPT TABLE – DOUGLAS-FIR-INTERIOR	PDF	HFP	Forest Practices	1997/02/01	HFP
415G	GROWTH INTERCEPT TABLE – SUBALPINE FIR-INTERIOR	PDF	HFP	Forest Practices	1997/07/01	HFP
415H	GROWTH INTERCEPT TABLE – WESTERN HEMLOCK-INTERIOR	PDF	HFP	Forest Practices	1998/11/01	HFP
415I	AVERAGE SITE INDEX RELATIONSHIP	PDF	HFP	Forest Practices	1998/11/01	HFP
415J	GROWTH INTERCEPT TABLE – WESTERN LARCH	PDF	HFP	Forest Practices	2000/05/01	HFP
415k	GROWTH INTERCEPT TABLE – WESTERN REDCEDAR	PDF	HFP	Forest Practices	2000/05/01	HFP
466	INSECT & DISEASE COLLECTION	PDF	HFP	Forest Practices	1996/08/01	HFP
657	SILVICULTURE SURVEY	PDF	OPC	Forest Practices	1998/10/06	HFP
658	SILVICULTURE SURVEY PLOT	PDF	OPC	Forest Practices	1998/09/01	HFP
659	SILVICULTURE SURVEY SUMMARY	PDF	OPC	Forest Practices	1998/09/01	HFP
660	SILVICULTURE SURVEY REFERENCE (525kb!)	PDF	OPC	Forest Practices	1997/02/01	HFP
703	PLANTING DIFFICULTY RATING	PDF	OPC	Forest Practices	1997/11/17	HFP
704A	PLANTING QUALITY INSPECTION (540kb!)	PDF	OPC	Forest Practices	1998/06/10	HFP

FS No.	Form name	Format	Paper supply	Business area	Version	OPR
704DRY	PLANTING INSPECTION REPORT	PDF	OPC	Forest Practices	1997/04/01	HFP
704WET	PLANTING INSPECTION REPORT	PDF	OPC	Forest Practices	1997/04/01	HFP
707	SURVIVAL STAKED PLOTS	PDF		Forest Practices	1997/11/17	HFP
708B	MLSIS FORM B	PDF	HFP	Forest Practices	2000/06/30	HFP
708C	MLSIS FORM C	PDF	HFP	Forest Practices	2000/06/30	HFP
739	PLANTING SITE PRESCRIPTION	PDF	OPC	Forest Practices	1997/11/17	HFP
747	DAMAGE AGENT AND CONDITION CODES – REF	PDF	OPC	Forest Practices	1999/01/28	HFP
748	PRE-STAND TENDING SURVEY	PDF	OPC	Forest Practices	1997/11/17	HFP
749	POST-SPACING EXAMINATION	PDF	OPC	Forest Practices	1997/11/17	HFP
770	PRE-STAND TENDING SITE DESCRIPTION/PRESCRIPTION	PDF		Forest Practices	1991/07/01	HFP
810A	FOREST COVER DATA ENTRY LIST	PDF		Resources Inventory	11/17/97	HRI
844	SURVIVAL STAKED LINES	PDF	HFP	Forest Practices	1997/11/18	HFP
879	RECONN. SURVEY FIELD CARD	PDF		Forest Practices	1994/09/01	HFP
922	FOREST COVER ATTRIBUTE	PDF	OPC	Forest Practices	1999/04/27	HFP